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TECHNICAL MEMORANDUM
LOWER AQUIFER INVESTIGATION REPORT

AMERICAN CHEMICAL SERVICE, INC.
NPL SITE
GRIFFITH, INDIANA

PREPARED FOR:
ACS RD/RA EXECUTIVE COMMITTEE

• • •
PREPARED BY:
MONTGOMERY WATSON
ADDISON, ILLINOIS

SEPTEMBER 1996



MONTGOMERY WATSON

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EXECUTIVE SUMMARY

This Technical Memorandum has been prepared to summarize the investigation activities and results of the Lower Aquifer Investigation conducted at the American Chemical Service, Inc. NPL site in Griffith, Indiana during January, February, and March, 1996. The primary objectives of the investigation were to characterize the hydrogeology of the lower aquifer, define the site stratigraphy, determine the horizontal and vertical gradients, identify dense, non-aqueous phase liquids (DNAPLs) if present in the lower aquifer, and to determine the horizontal and vertical extent of lower aquifer contamination. Documentation of private wells within the vicinity of the ACS facility (e.g. 2-mile radius) was an objective added during the investigation. Results from the Lower Aquifer Investigation augment lower aquifer data presented in the June 1991 Remedial Investigation (RI) report.

Investigation activities were conducted in accordance with the Lower Aquifer Investigation SOW and SOPs, approved with modifications by the U.S. EPA on January 25, 1996. Continuous core sampling and vertical profiling across the lower aquifer were conducted at four locations using rotosonic drilling methods. Vertical profile samples were collected at ten-foot intervals from the top to the bottom of the lower aquifer and analyzed for target VOCs with an on-site field gas chromatograph (GC). Following completion of coring and vertical profiling, nine monitoring wells and three piezometers were installed in the lower aquifer at six locations. The wells were subsequently developed and sampled for VOCs, semi-volatile compounds, PCBs, and inorganic parameters (total and dissolved). Continuous and "snapshot" water levels were measured in lower aquifer wells and piezometers.

Other investigation activities completed for the Lower Aquifer Investigation included evaluation and sampling of ACS production wells and identification of private wells located in the vicinity of the upper aquifer groundwater contamination detected during the Upper Aquifer Investigation.

The results of the Lower Aquifer Investigation indicate that the stratigraphy of unconsolidated deposits at the ACS site consists of an upper and lower sand aquifer separated by a clay confining layer. The thickness of the upper clay confining layer varies from 4 feet to the north to 35 feet to the south. Underlying the upper confining layer, the lower aquifer consists of well sorted gray to brown fine sand which varies in thickness between 40 to 68 feet. Below the lower aquifer is the lower clay confining layer. It is about 12 to 20 feet thick and overlies dark gray shale bedrock.

Water levels measured on March 15, 1996 at the lower aquifer wells and piezometers indicate that the vertical gradients are relatively low and variable. Values ranged from 0.0007 upward at one location, to 0.005 downward at another location. At the five locations where gradients were calculated, the overall gradient from the top to bottom of the lower aquifer was downward at three locations, upward at one location, and there was no overall vertical gradient at the fifth location. The horizontal gradient in the lower aquifer measured on March 15, 1996 was northward with a value of 0.00047. The direction of the

gradient was consistent with previous measurements and the value of 0.00047 was consistent with the findings from the October 30, 1995 measurements.

The bottom of the zone of contamination in the lower aquifer in the vicinity of existing monitoring well MW9 was successfully confirmed by the placement of MW29 during this investigation. Therefore no further investigation or monitoring well installations are recommended at this location. However these points will be included in the monitoring program.

Although potential VOC contaminants were indicated by the field GC analysis of two samples from vertical profile VP3 (the well nest containing MW8, MW31, and MW32), subsequent sampling of MW31 and MW32 did not confirm the detections. Total VOC concentrations of approximately 14 ug/L were found in lower aquifer water samples collected from two ACS production wells (IW1 and IW4).

Several of the lower aquifer monitoring well samples contained phthalates at concentrations between the detection level and 100 ug/l. A common source for low levels of phthalates is laboratory contamination. However, since phthalates are included in the list of compounds with remediation levels in the Site ROD, the occurrences will be further evaluated during the monitoring program. Except for the phthalate anomaly, there were no exceedances of remediation levels in samples collected at the downgradient site boundary (north side of the site) in the lower aquifer. PID readings during the field investigation indicated the potential for contamination in the upper few feet of the lower aquifer at monitoring well location MW10. However, no monitoring well was installed at this location, since monitoring well MW10 was already screened 10 to 15 feet below the clay confining layer that marks the top of the lower aquifer. A new monitoring well with a ten-foot screen will be installed, extending from just below the confining clay from elevation 613 feet above mean sea level to 603 feet above mean sea level. This new well will replace existing monitoring well MW10 in the ongoing monitoring plan.

A zone of upper aquifer contamination was better delineated during the Upper Aquifer Investigation. Chloroethane and benzene were detected at levels below remediation levels and MCLs at private well PW02, which appears to be drilled through the zone of upper aquifer contamination. An additional lower aquifer well will be installed downgradient of the PW02 location to evaluate the lower aquifer in this area. The monitoring wells are scheduled for installation in mid-October 1996. It has been assumed that these two new wells will be included in the sampling planned for the end of October 1996.

The nature of the contamination in the lower aquifer at the Site has been defined to date by the compounds detected at monitoring well MW9, the trace levels of PCE and xylenes in the samples from ACS production wells IW1 and IW4, and from the oily sheen observed in the water in production well IW6. Production wells IW5 and IW6 may provide a route for contaminants to move from the upper aquifer to the lower aquifer. Given the high levels of contamination inside the ACS Site and the strong downward gradients from the upper to lower aquifers, decisions regarding the placement of additional lower aquifer wells within the Site boundaries will be deferred until after the upper aquifer groundwater treatment

system is operational. At that time, the highly contaminated areas may be dewatered and the strong downward gradient will be eliminated.

The two abandoned and the four currently used ACS production wells will be further investigated by sounding and geophysical logging. They will be sampled for TCL/TAL parameters and then permanently abandoned by sealing with grout. A sample of the material with the oily sheen in well IW6 will be collected and analyzed for TCL parameters. A plan for the ongoing monitoring of the lower aquifer is presented as part of this document.

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INTRODUCTION

This Technical Memorandum summarizes the investigation activities and results of the Lower Aquifer Investigation conducted at the American Chemical Service, Inc. NPL site in Griffith, Indiana during January, February, and March 1996. The investigation was conducted in accordance with the Lower Aquifer Investigation SOW and SOPs, approved with modifications, by the U.S. EPA on January 25, 1996. Results from the Lower Aquifer Investigation augment the lower aquifer data presented in the June 1991 Remedial Investigation Report (RI).

1.1 OBJECTIVES

The objectives of the Lower Aquifer Investigation were to:

1. Determine the stratigraphy of the lower aquifer.
2. Determine the horizontal and vertical extent of lower aquifer groundwater contamination.
3. Determine if contaminants have reached the downgradient point of compliance from the Site and if so, determine their vertical concentration profile in the lower aquifer.
4. Determine the horizontal and vertical gradients in the lower aquifer.
5. Determine if dense, non-aqueous phase liquids (DNAPLs) are present in the lower aquifer.
6. Identify the residential drinking water wells within a two-mile radius of the site.

1.2 SCOPE OF WORK

The following activities were completed to meet the objectives of the Lower Aquifer Investigation:

- Continuous core samples of the lower aquifer matrix material were collected to the base of the lower aquifer at four locations using a rotosonic drilling method.
- Vertical profiling was conducted across the lower aquifer at four locations. Groundwater samples were collected at ten-foot intervals from the top to the bottom of the lower aquifer and analyzed for target VOCs with the on-site field gas chromatograph (GC).
- Eight monitoring wells and three piezometers were installed in the lower aquifer at six locations.
- Water levels were measured in lower aquifer wells and piezometers.
- The four current ACS production wells were sampled for VOCs.
- Chemical time-series samples were collected at ACS production well IW1 and analyzed with the field GC.
- The two abandoned ACS production wells were inspected.
- Water levels were measured and recorded in two monitoring wells and one piezometer continuously for approximately 30 days.
- Private wells located within a two-mile radius of the ACS facility were reviewed to identify potential private drinking water sources .

Field Activities

2.1 DRILLING

2.1.1 Setting Casing

Surface casing was initially installed at all boring locations to prevent potential downward migration of upper aquifer contaminants to the confined lower aquifer. The eight-inch diameter casings were set, using a hollow stem auger drilling rig. The casings were set a minimum of 12 inches into the clay confining layer found between the upper and lower alluvial aquifers. The casings were sealed in place with cement bentonite grout.

2.1.2 Continuous Coring

Borings into the lower aquifer were conducted at six well locations surrounding the ACS facility: MW9, MW10, MW8, MW7, MW28, and M4 (Figure 1). At the first boring at each of the six locations, continuous core samples were collected with rotosonic drilling methods, starting at the base of the surface casing and continuing to the base of the lower aquifer. Cores were collected in ten foot lengths, extruded into core sleeves and stored in boxes staged on site. The cores were evaluated, logged, photographed, and screened for the presence of VOCs in the aquifer matrix using the PID headspace method. Table 1 identifies the number and location of continuous cores collected during the Lower Aquifer Investigation.

Drilling was conducted in accordance with the approved Sonic Drilling Sampling Protocol SOP for the Lower Aquifer Investigation (revision: January 25, 1996) with the following exception:

- Borings were extended to bedrock at the PZ43 (MW17) and MW10 (VP02) locations to determine the thickness of the lower clay and characterize the bedrock.

Boring logs for lower aquifer wells and piezometers are included in Appendix A.

2.1.3 Vertical Profiling

The objective of determining the presence of DNAPLs and screening for the vertical and horizontal extent of VOCs in the lower aquifer was accomplished by vertical profiling at four downgradient locations. Vertical profile samples, labeled with a VP designation, were collected at MW9 (VP1), MW10 (VP2), MW8 (VP3) and M4 (VP4) (Table 1). Continuous cores of aquifer material were brought to the surface during the drilling and each core was examined inch by inch, for any sign of NAPLs and to document the geologic material and strata. The locations of the vertical profile samples are shown on Figure 1.

After each ten-foot core run was extracted from the borehole, a power punch was inserted into the zone that was just cored. The water-tight power punch casing was subsequently retracted to expose a four-foot long, 1.75-inch diameter screen. Groundwater was then purged and sampled using a Grundfos submersible pump, which was set two feet above the filter pack applied to the power punch well screen. The flow rate during purging was approximately 300 milliliters/minute and it was decreased to 200 milliliters/minute during sample collection. The amount of groundwater purged and flow rate used to purge is presented in Appendix B. While water is used in the roto-sonic drilling method, there were no significant losses of drilling water, because the drilling was conducted in a saturated sand formation.

Vertical profiling was conducted in accordance with the approved Sonic Drilling Sampling Protocol SOP for the Lower Aquifer Investigation (revision: January 25, 1996) with the following exceptions:

- Fine sandy soils were encountered during the vertical profiling activities. These sands often caused the screen of the power punch to become clogged. To address this difficulty, with concurrence from the U.S. EPA, filter pack sand was placed inside the power punch screen prior to installation to prevent sand from flowing into the power punch.
- The power punch was typically installed near the top of the cored interval rather than the center (i.e., if the core run was 25 to 35 feet, the power punch was installed from 25 to 29 feet). The modification was necessary because of the drilling platform heights and lengths of drill strings.

Vertical profiling purging and sampling information is presented in Appendix B.

2.1.4 Field GC

Groundwater samples from the vertical profiling were screened for target VOCs using a field GC. The target VOC list included the following compounds: acetone, 1,1-dichloroethene (1,1-DCE), cis- and trans-1,2-dichloroethene, methyl ethyl ketone, 1,2-dichloroethane (1,2-DCA), 1,1,1-trichloroethane (1,1,1-TCA), benzene, carbon tetrachloride, trichloroethene (TCE), methyl isobutyl ketone (MIBK), 1,1,2-trichloroethane, toluene, tetrachloroethene (PCE), chlorobenzene, ethylbenzene, m+p xylene, styrene and o-xylene.

All field GC analyses were performed in accordance with the approved SOP for the Lower Aquifer Investigation (Field GC - Purgeable Volatiles Analysis Protocol, revision: January 25, 1996).

2.2 WELLS AND PIEZOMETERS

2.2.1 Installation

Following completion of continuous coring at vertical profile locations, a monitoring well or piezometer was installed at the base of the aquifer. At each location, a second monitoring well or piezometer was then set at the approximate midpoint of the lower aquifer in a second borehole, which was not cored. At MW7 and MW28, where vertical profiling was not conducted, the first boring was cored to the base of the aquifer and a well or piezometer was screened at the base of the lower aquifer. A second boring was then installed at the approximate midpoint of the lower aquifer.

With the exception of location M4, where a thicker clay confining layer was encountered, each lower aquifer drilling location presently contains three screened devices (monitoring wells or piezometers), one near the base of the lower aquifer, one at the approximate midpoint of the lower aquifer, and one at the top of the lower aquifer. A summary of monitoring well and piezometer installation activities is presented in Table 1. Monitoring well and piezometer coordinates, ground and top-of-casing elevations, and construction details are presented in Table 2.

Well and piezometer installation was conducted in accordance with the approved Sonic Drilling Sampling Protocol SOP for the Lower Aquifer Investigation (revision: January 25, 1996) with the following exceptions:

- Because VOCs were detected at the base of the lower aquifer at MW8, with U.S. EPA concurrence, the deep PVC piezometer scheduled for installation at the base of the lower aquifer was replaced with a two-inch diameter stainless steel monitoring well with a ten-foot screen. The planned piezometers were replaced by monitoring wells in the lower zone at MW7, MW8, MW9, MW10 and M4 locations following U.S. EPA approval.
- Because the lower aquifer was thinner than estimated in the work plan (the bottom of the lower aquifer was encountered at an elevation of approximately 540 feet above mean sea level (amsl) rather than 510 feet amsl estimated in the Work Plan), wells or piezometers installed in the middle zone were not screened at the 550 foot amsl elevation. Screen elevations for wells and piezometers are shown on Table 2. Vertical placement of the wells or piezometers in the middle zone of the lower aquifer was based on placement criteria stated in the Lower Aquifer Investigation SOW. This criteria indicated that wells or piezometers would be installed either at a depth exhibiting the highest concentrations of contamination detected by the

vertical profiling, or, if no contamination was found, the well or piezometer would be installed at a depth representative of the middle zone of the aquifer.

- At the M4 location, the upper confining layer was significantly thicker than observed elsewhere at the ACS site and the lower aquifer correspondingly thinner. The thickness of the lower aquifer at this location was approximately 40 feet. Because of the reduced thickness of the lower aquifer, only two screened devices are presently installed at the M4 location; monitoring well MW35 at the base of the lower aquifer, and existing well M4 screened at the top of the aquifer. The elevation of the upper zone at existing well M4 is laterally equivalent in elevation to the other middle zone wells installed during the lower aquifer investigation. Surface casing which was installed at M4 for placement of the middle zone well was left intact and sealed at the ground surface. The U.S. EPA oversight contractor was informed of the field judgment call not to install the third piezometer vertically between M4 and MW35. It is recognized that a middle zone well or piezometer could be installed at this location at a later date, if necessary, using the existing surface casing.
- Item number VI.B.6.c. of Installation of Wells and Piezometers in the SOP contains an error. The SOP states that six inches of fine sand should be placed above the bentonite seal. Actually, the fine sand is intended to prevent intrusion of the bentonite seal into the filter pack. Therefore, the fine sand was placed between the filter pack material and the bentonite seal. This field modification was made at all wells with the concurrence of the U.S. EPA oversight contractor.
- The protective covers were not set in a bed of sand. This was not done because the base of the protective covers were placed inside permanent casings installed as part of the surface casing installation activities. The permanent casings would not allow for drainage of water to occur that may have accumulated inside the protective cover. Weep holes were subsequently drilled into the stick-up well protectors to allow drainage of water.
- Brass locks were installed on all new wells and piezometers. Therefore, the locks did not require lubrication as stated in the SOP.

Well construction forms for lower aquifer wells and piezometers are included in Appendix C.

2.2.2 Development

Following installation of monitoring wells and piezometers in the lower aquifer, the wells and piezometers were surveyed and developed. Development was conducted in accordance with the approved March 1996 Well Development SOP for the Lower Aquifer Investigation with the following exceptions:

- Monitoring wells MW31, MW32, and MW33 were each surged for ten minutes using a bailer rather than the 20 to 30 minutes indicated in the SOP. After development of all wells except MW31, MW32, and MW33, it was apparent that using the submersible pump to surge the wells during development was more effective in removing sediment from the filter pack than the bailer. Additionally, by using the pump to surge the well, specific zones within the well screen were incrementally developed by slowly raising and lowering the pump through the screened interval during purging. This field modification was made with the concurrence of the U.S. EPA oversight contractor.
- The submersible pump was not allowed to rest stationary at the well bottom. If the pump motor was positioned at the base of the pump (and not the intake), resting the pump at the bottom of the well would not let water flow around the motor and could potentially cause the pump to overheat. Additionally, the use of the pump to surge the well did not allow the pump to remain stationary at the bottom of the well.
- The relative recovery of the wells was not measured following development. This was not done because the pump was not equipped with a check valve to prevent backflow of water contained in the pump hosing from flowing back into the well. Therefore, as soon as the pump was turned off, the water contained within the pump hosing would flow back into the well and cause the water level in the well to become artificially recharged. Measurement of recharge would then be biased by the volume of water contained within the hose.

Well development forms are included as Appendix D.

2.3 WATER LEVELS

2.3.1 Continuous Measurements

To further evaluate the hydraulic characteristics in the lower aquifer, continuous water level readings were monitored with transducers and data loggers at MW7, MW9, and P-8 for a period of approximately 30 days during the lower aquifer investigation. The continuous monitoring was conducted to provide an extended record of variability of water levels in the upper and lower aquifers at the site.

Continuous monitoring activities were performed in accordance with the approved SOP for the Lower Aquifer Investigation (Groundwater Level Monitoring using Two-Channel Hermit Data Logger, April 1993) contained in the January 25, 1996 Lower Aquifer Investigation SOW and SOP. The data loggers were checked and downloaded every five to seven days to ensure they were functioning and recording representative data.

2.3.2 Snapshot Gauging Event

To determine horizontal and vertical gradients in the lower aquifer, water level measurements were made at new and existing lower aquifer wells and piezometers on March 15, 1996. Lower aquifer wells at the City of Griffith landfill (M1 through M5) were not measured because access could not be obtained from the landfill's consultant during the time frame requested.

2.4 ACS PRODUCTION WELLS

2.4.1 Current Wells

Four existing and two abandoned production wells were identified at the ACS facility in the Lower Aquifer SOP. Wells IW1 through IW4 are active wells which are currently used by ACS. The wells consist of four inch diameter casing which were formerly operated on a daily basis. The four active wells were sampled during the lower aquifer investigation and samples were analyzed by the laboratory for TCL VOCs. The four active production wells are integrally connected to the water supply system and are sealed at the surface, therefore water level information could not be collected. Sampling was conducted in accordance with the approved SOP, Active Production Well Evaluation and Sampling, for the Lower Aquifer Investigation (revision: January 25, 1996).

2.4.2 Abandoned Wells

The abandoned production wells IW5 and IW6 were inspected and field evaluated to determine:

- The surrounding casing and physical condition of the casing
- The total well depth and the depth to water
- The presence of any non-aqueous phase liquid in the well
- The feasibility of reclosing the well

Evaluation of the abandoned ACS production wells was conducted in accordance with the approved SOP, Abandoned Production Well Evaluation for the Lower Aquifer Investigation (revision: January 25, 1996).

2.4.3 Time-Series Sampling

On February 23, 1996, a series of water samples was collected from production well, IW1, during continuous pumping. The objective of the time-series sampling was to document variability in the concentrations of VOCs in IW1 (see Section 5.2) behaved in response to the continuous withdrawal of water from the well. Sampling was conducted in accordance with the approved SOP, Active Production Well Evaluation and Sampling for the Lower Aquifer Investigation (revision: January 25, 1996). Because the well was operated continuously over the eight hour period of sampling, it was assumed that the running water was representative of new formation water. Therefore, temperature measurements were not collected during sampling.

HYDROGEOLOGY OF THE LOWER AQUIFER

3.1 GEOLOGY

The geology and stratigraphy of the unconsolidated aquifers and confining layers was developed from a detailed inspection of the continuous cores, and grain size tests from discrete intervals in each of the six boring locations. Boring logs for existing well locations (MW9, MW10, MW8, MW7, MW28, and M4) are presented in Appendix A1; boring logs generated during the Lower Aquifer Investigation are included in Appendices A2 through A7. Stratigraphic depths, elevations and thickness of geologic units encountered at the site are summarized in Table 3. A location map of cross sections through the site is presented in Figure 2. Figure 3 shows the western cross section through the monitoring well locations PZ43, MW35, MW34, and MW33; Figure 4 presents the central cross section through PZ43, MW36, and MW8, and Figure 4A presents a cross section through the western most available boring locations. Grain size distribution test results are presented in Table 4 and grain size reports are included in Appendix F.

As shown by the cross sections, the unconsolidated stratigraphy of the ACS site is generally uniform and consists of an upper and lower sand aquifer separated by a clay confining layer. Another clay confining layer was identified between the lower aquifer and the bedrock (Figures 3, 4, and 4A). Each of these hydrogeologic units is described below.

3.1.1 Upper Aquifer

Based on geotechnical results presented during the March 1996 Barrier Wall Alignment Investigation Report, soils of the upper aquifer are generally classified as a fine to coarse sand with a trace to some silt and clay. The soils encountered were classified with the Unified Soil Classification System (USCS) symbols of SP, SP-SM, and SM. The upper aquifer varied in thickness from approximately 27.5 feet at MW28 southeast of the site to 13.5 feet at MW33 to the northwest. At MW35, the upper aquifer was only 13 feet thick, which may be due to excavation activities at the Griffith landfill. More data on the geology of the upper aquifer is presented in the June 1991 Remedial Investigation (RI) Report.

3.1.2 Upper Clay Confining Layer

From the RI investigation, it was evident that the upper clay confining layer was greater than 20 feet thick to the south of the site and that it thinned to less than five feet north and west of the ACS Site.

However, even after making three boreholes to install MW10C during the RI, uncertainty remained regarding the thickness of the confining clay layer in an area 300 feet northwest of the ACS facility (Figure 2). Three boreholes were made in March and April 1990 to place a well at the MW10C location. The drillers experienced difficulty in maintaining an open hole and collecting representative samples. An additional soil boring, CB-1, was advanced to determine the clay thickness in the vicinity of MW 10C. The thickness of clay in CB-1 appeared to be approximately 2.5 ft. The boring logs for MW10A, MW10B, MW10C, and CB-1 are included in Appendix A1, and these show the uncertainty in the thickness of the clay layer that remained after the RI. Approximately 3.5 feet of lean clay was indicated between a depth of 15.5 and 19 feet at boring MW10A. Approximately four feet of silty and sandy clay were indicated between a depth of 17 and 21 feet at MW10B. Approximately four feet of clay and silty clay were indicated at a depth of 16 feet in the borehole for MW10C.

During the RI, to evaluate the potential that this location might represent a discontinuity in the clay confining layer, a monitoring well was placed at borehole MW10C (Figure 2). Although the logs indicate thin clay layers that are silty and sandy, the hydraulic data has indicated that a low permeability layer does exist. The water levels in monitoring well have been consistently similar to the lower aquifer rather than the upper aquifer levels. The water level elevation at MW10C at the October 30, 1995 water level measurement was 619.77 feet amsl. The water table elevation in the upper aquifer in the vicinity of MW10C was 629.15, as indicated by piezometer P-25. These water levels indicate that the strong downward gradient that exists elsewhere on site, where the clay confining layer has been confirmed to exist, also is found at location MW10C.

Borings made during the RI and the Dewatering/Barrier Wall Investigation show that the upper surface of the clay confining layer is generally encountered within 2 feet of 620 feet amsl. During this investigation the upper clay confining layer was observed between 617 feet amsl (VP03 location) and 621 feet amsl (MW28 and VP02 location). During the RI investigation the upper clay confining layer was observed at an elevation of 614 feet amsl in MW22. The highest elevation of the upper clay confining layer was observed at MW18, at an elevation of 625 feet amsl. The clay confining layer is generally classified as clay with a USCS symbol of CL. The thickness of the confining unit documented during the lower aquifer investigation was consistent with the findings in the RI. It appears to thin from the south to northwest (Figure 3). At the southern portion of the site at MW35 and PZ43, the clay is 35 feet thick and 31 feet thick, respectively. At the northern side of the site, at MW33, the clay thickness is four feet thick.

According to the rigid-wall falling head permeability testing performed for the Barrier Wall Alignment Report (U.S. Army Corps of Engineers Method EM 1110-2-1906 (VII)), the permeability of the upper clay confining layer ranged from 1.7×10^{-8} cm/s (centimeters per second) to 2.4×10^{-8} cm/s based on relatively undisturbed Shelby tube samples collected during the Dewatering/Barrier Wall Investigation early in 1996. (These results are similar to the results obtained in the RI.) Liquid and plasticity limits ranged from 28 to 30% and 11 to 14%, respectively.

3.1.3 Lower Aquifer

The top of the lower aquifer was encountered at elevations ranging from 614 feet amsl at MW33 located northwest of the ACS facility to 584 feet amsl at MW35 (Figure 3; Table 3). Where the upper clay layer was thinner (MW33), the top of the lower aquifer was found at higher elevations.

The geology of the lower aquifer is a well sorted gray to brown, dense, fine sand, with a trace of silt and clay (Appendix A). Grain size analyses of grab samples taken from various depths during rotosonic drilling indicates the general uniformity of the lower aquifer, with most sand fractions accounting for more than 90 percent of the total grain size fraction (Table 3). The soils encountered were classified with the USCS classification symbols of SP, SP-SM, and SM. No varves or bedding planes were evident in any of the continuous cores. In general, the rotosonic drilling appeared to provide relatively undisturbed cores of the unconsolidated lower aquifer material.

Some intervals within the lower aquifer contain occasional zones with more gravel or silt and clay fractions. At PZ43, basal sand and gravel was found at a depth of 96 to 98 feet immediately overlying the lower clay confining unit (Appendix A). At MW35, the lower aquifer contains more gravel at a depth of 48 to 55 feet (32% gravel at 55 feet; Table 4) and is siltier from 82 to 88 feet (14% silt and clay at 85 feet; Table 4). At MW31 and MW32, fine to coarse sand was encountered from 64 to 78 feet, and a cobble was found at 69 feet (Appendix A). Grain size analysis of a grab sample at 70 feet from MW31 indicated a gravel percentage of 13% (Table 4).

Based on borings made through the lower aquifer, the basal surface of the lower aquifer is relatively flat and ranges between 540 and 550 feet amsl (Table 3). The thickness of the lower aquifer varies between approximately 40 feet to the south (MW35 and PZ43), and 65 feet to the north and northwest (MW32 and MW33).

3.1.4 Lower Confining Layer

A lower clay confining unit underlies the sands of the lower aquifer at elevations between 540 feet to 550 feet amsl (Table 3). This lower confining unit consists of predominantly stiff, gray, lean silty clay with a trace of fine sand and gravel (Appendix A). The thickness of the lower confining unit was penetrated at the PZ43 and MW33 locations. At these locations, the clay unit was 12.5 feet and 20 feet thick, respectively.

3.1.5 Bedrock

Dark gray shale was the uppermost bedrock unit encountered at the site. Shale was found at PZ43 and MW33 locations at elevations of 538 feet and 527 feet amsl, respectively. No other borings were extended through the lower clay during the Lower Aquifer Investigation.

3.2 WATER LEVEL MEASUREMENTS

Water level measurements were made at new and existing lower aquifer wells on March 15, 1996. Lower aquifer wells at the City of Griffith landfill (M1 through M5) were not measured because access could not be obtained from the landfill's consultant in the time frame available. The measured water level depths and calculated groundwater elevations are tabulated in Table 5. Depth to water in the lower aquifer ranged between 11.16 feet at MW23 to 25.80 feet at MW28 (Table 5).

The average water level elevation in the lower aquifer was approximately 622 feet amsl. Water levels in the upper aquifer averaged approximately 630 feet amsl as reported in the Upper Aquifer Investigation Technical Memorandum

3.3 VERTICAL GRADIENTS

Table 6 presents vertical hydraulic gradients measured between nested wells installed in the lower aquifer. Vertical gradients were calculated by dividing the difference in head between nested wells by the distance between the screen midpoints for the wells. Because access could not be obtained at M4, the vertical gradients between M4 and MW35 could not be determined.

Vertical gradients between grouped wells ranged from 0.0007 upward in the middle zone at MW8 and MW10 locations, to -0.005 (downward) between MW10 and MW30 installed in the upper and middle zones of the lower aquifer (Table 6). The greatest difference in groundwater elevation between nested wells was -0.11 feet at MW10 and MW30. Because of the head difference observed between MW10 and MW30, the continuous core collected at this location (MW33 core) was reexamined. A slight coarsening in sand grain size was observed between the upper portion of the lower aquifer screened by MW10 and the middle portion of the lower aquifer screened by MW30. No evidence of silt or clay layers was found in the core at this depth.

Other lower aquifer well nests exhibited head differences less than 0.10 feet (Table 6). The final column on Table 6 shows the calculated vertical gradient from the top to the bottom of the lower aquifer. Well nests, MW8/MW32, MW9/MW34, and MW28/PZ43, did not exhibit any vertical gradients between wells installed at the top of the lower aquifer to wells installed at the bottom of the aquifer. Although the vertical gradients appear to be an order of magnitude higher than horizontal gradients, the gradients are calculated from very small difference in head, across much shorter distances than the horizontal gradients. The variability of the vertical gradient data indicates that there is not an overall trend to vertical gradients, but that the primary groundwater flow is horizontal in the aquifer.

Based on the difference in groundwater elevation between the upper and lower aquifer (approximately 8 feet), there is a strong downward vertical gradient through the upper confining layer between the two aquifer systems. Using an average water level difference of

8 feet between the upper and lower aquifers, and considering the upper confining layer thickness at MW35 (35 feet thick) and MW33 (4 feet thick) to bound the range of thicknesses for the confining unit, the vertical gradients calculated between the two aquifer ranged from 0.23 to 2, respectively. This suggests that the low permeability of the upper confining layer (2×10^{-8} cm/s) provides a substantial barrier to vertical groundwater flow between the two aquifers. The permeability of the upper confining layer is based on the data collected during the Dewatering/Barrier Wall investigation conducted in January and February 1996.

3.4 GROUNDWATER FLOW DIRECTION

Figure 5 shows the groundwater potentiometric surface in the lower aquifer. The direction of horizontal groundwater flow in the lower aquifer is generally northward. This information is based on water levels measured in lower aquifer wells installed at the top of the aquifer. These wells were utilized for groundwater flow determinations because: 1) most lower aquifer wells at the ACS site are screened at the top of the aquifer which subsequently provide more data points for the potentiometric surface contour plot; 2) water level data from the top of the lower aquifer are comparable to water level data previously collected for the lower aquifer; and 3) the lack of consistent vertical gradients in the lower aquifer suggests that horizontal flow at the top of the aquifer is the same as horizontal flow at the base of the aquifer. The northward direction of groundwater flow in the lower aquifer is consistent with lower aquifer data presented in June 1991 RI and the October 30, 1995 Technical Memorandum.

The horizontal hydraulic gradient in the lower aquifer was determined to be 0.00047, as measured from MW22 located in the southern portion of the site, to MW10 located at the northern site boundary. The gradient was determined by dividing the difference in head between the two wells (1.35 feet) by the lateral distance (2,850 feet). The resultant gradient (0.00047) is consistent with lower aquifer gradients presented in the RI report (gradient = 0.0006) and the October 30, 1995 Technical Memorandum (gradient = 0.00041). Although the vertical gradients appear to be much stronger than the horizontal gradients, the distance over which they are calculated and the variability are the primary factors in evaluation. There is little variability in the horizontal gradients, and there is high variability in the vertical gradients. The horizontal gradients are based on small differences in water level over a long distance (nearly 3,000 feet). The vertical gradients are based on very small differences in water level over short distances (10 to 30 feet). It is reasonable to conclude that the primary motive force acting on groundwater is horizontal, with small locally controlled vertical components.

3.5 CONTINUOUS WATER LEVEL MEASUREMENTS

Continuous water level measurements were recorded at three monitoring wells during the Lower Aquifer Investigation using pressure transducers and data loggers. Two wells monitored the upper and lower aquifer at one location (P8 and MW7, respectively) and one well (MW9) monitored the lower aquifer at a second location. The data collection activities are summarized below:

Well No.	Start Date	Start Time	End Date	End Time
P8	2/7/96	1610	3/5/96	1130
MW7	2/7/96	1610	3/5/96	1130
MW9	2/2/96	1000	3/5/96	1220

Due to a data logger malfunction, water level information at P8 and MW7 from February 2 to February 7, 1996 was not collected. Figure 6 shows a plot of the continuous water levels for the nested pair, P8 and MW7, and Figure 7 presents a plot of MW9. Raw data and plots of continuous water levels over consecutive ten-day periods are included in Appendix G.

The continuous water level data for all three wells show a similar pattern of fluctuations in response to environmental conditions. At the nested well pair, P8 and MW7, the upper aquifer well P8 appears to exhibit greater magnitude of fluctuation than the lower aquifer well, MW7, although the water level trends between the two aquifer systems are similar. The total variability in water levels exhibited by the three wells during the period of continuous monitoring was approximately 0.7 feet in P8, 0.95 feet in MW7, and 1.0 feet in MW9 (Figures 6 and 7).

At both lower aquifer monitoring locations (MW7 and MW9), an increase in hydraulic head is noted over the last four days of continuous monitoring (February 27 through March 2). This increasing trend is also apparent in upper aquifer piezometer P8 on February 27 and 28. After February 28, the change in head in P8 stabilizes, whereas the lower aquifer wells, MW7 and MW9, continue to increase until March 2 (Figures 6 and 7).

Barometric data for the 30 days of continuous water level measurements were obtained from the Gary, Indiana airport, located approximately eight miles north of the ACS facility. The data was plotted on the same scale as the water level data and has been included in Appendix G1. By overlaying the barometric plot on the water level plot, one may observe the similarities and differences. Several generalizations can be made:

- Water levels in the two lower aquifer wells MW7 and MW9 are very similar to each other, indicating that the lower aquifer is responding to the same stresses at both locations.

- The water levels in piezometer P8, screened in the upper aquifer, show a greater magnitude of variation than the wells in the lower aquifer, and the variability closely reflects the variability in the barometric pressure, for the first 20 days. After that, the correlation decreases.
- The lower aquifer wells , MW7 and MW9, do not show as close a correlation to the barometric pressure as the upper aquifer piezometer.
- Evidence of pumping activities is not readily apparent in either the upper aquifer water level (P8) or in the lower aquifer water levels (MW7 and MW9).
- The primary changes in the water levels in both the upper and lower aquifer usually correlate to the changes in the barometric pressure. There are no discernible systematic variations from the barometric pressure. Therefore, there is not a sound basis for identifying pump cycles.

ANALYTICAL RESULTS

4.1 VERTICAL PROFILE SAMPLING RESULTS

Target VOC analytical results for vertical profile samples collected at MW9 (VP1), MW10 (VP2), MW8 (VP3), and M4 (VP4) are presented in Table 7. A total of 24 vertical profile samples were collected and analyzed with a field GC during the Lower Aquifer Investigation at the four locations. Seven samples were taken at approximate ten-foot intervals at MW9 and MW10, six samples were collected at MW8, and, due to the thickness of the overlying clay confining layer, four samples were obtained from the lower aquifer at M4.

Acetone was the only target VOC detected at MW9 (VP1) and MW10 (VP2) during the vertical profiling (Table 7). Acetone was detected at 10 ug/L in the sample collected at a depth of 39 feet at MW9, whereas at MW10, acetone was detected at 37.7 ug/L in the sample collected at a depth of 29 feet. Cis-1,2-dichloroethene and 1,2-dichloroethane were detected in samples collected at MW8 (Table 7). Cis-1,2-dichloroethene was indicated at a concentration of 10 ug/L in a sample collected at 69 feet and 1,2-dichloroethane was indicated at 56.5 ug/L (63 ug/L with a duplicate) in a sample collected at a depth of 99 feet.

No target VOCs were detected in vertical profile samples collected at M4.

4.2 LABORATORY ANALYTICAL RESULTS

New lower aquifer monitoring wells were sampled at the site on March 12 to 14, 1996 for VOCs, semi-volatile compounds, PCBs and metals. Laboratory analytical results for metals are presented in Table 8. A summary of groundwater analytical results (SVOCs and metals) where there were individual exceedences of the final remediation levels (Appendix B of the SOW), is presented in Table 8A. Laboratory analytical reports from IEA for VOCs, semi-volatile compounds and PCBs are included in Appendix H, and laboratory analytical reports for metals are included in Appendix I.

4.2.1 VOCs

The RI indicated that the lower aquifer was contaminated in the vicinity of monitoring well MW9. RI sampling indicated concentrations of chloroethane in the lower aquifer between 440 ug/L and 200 ug/L. The vertical profiling was conducted at the MW9 location to

determine the vertical extent (depth) of contamination in the lower aquifer at this location. Monitoring well MW29 was installed specifically to sample the base of the zone of contamination. Chloroethane was estimated at a concentration of 2 ug/L (J-value) in the sample collected from MW29 during March 1996. This trace concentration is an indication that the zone of contamination extends from the base of the clay to a depth of approximately 60 feet in the lower aquifer. No other VOCs were detected in monitoring well samples (Appendix H). (Elevated PID readings were recorded in the upper few feet of the lower aquifer at monitoring well location MW10. Further investigation, as described herein, will be conducted at this point to evaluate potential downgradient effects.)

4.2.2 Semi-volatiles and PCBs

Bis(2-ethylhexyl)phthalate, for which a remediation level was defined in the SOW to the ROD, was detected in samples collected from MW29, MW30, MW32, and MW35 at concentrations ranging between 11 ug/L and 68 ug/L (Table 8B and Appendix H). This compound is a potential laboratory contaminant. It is used primarily as a plasticizer for producing plastics such as polyvinyl chloride (*Handbook of Environmental Data on Organic Chemicals, Second Edition*, Verschuere, 1983). However, since phthalates were included in the compounds with listed remediation levels in the SOW of the ROD, they will be further evaluated in the monitoring program to be started later in 1996. Phenol was detected at an estimated concentration of 6 ug/L in MW33. No other semi-volatile organics or PCBs were detected in monitoring well samples (Appendix H).

4.2.3 Inorganics

Groundwater samples from new lower aquifer wells were analyzed for total and dissolved inorganics (Table 8A). Major groundwater constituents, calcium, magnesium and sodium were detected at the highest concentrations in the lower aquifer, followed by detections of minor metal constituents, iron, potassium, manganese, and aluminum (Table 8A). Other metals were generally not detected or were found below quantitation limits ("B" designation on Table 8A).

The highest metals concentrations were generally detected at MW33 (northwest portion of the site). Several total and dissolved constituents were found in this well at levels three to five times concentrations detected in other wells at the site, including concentrations detected in nested well MW30. The highest concentrations were associated with major and minor groundwater constituents (calcium, magnesium, and sodium, iron, potassium). Manganese was detected at a level approximately three times above the remediation level for manganese. However that detection was less than three times the average concentration for the manganese detected in all new lower aquifer monitoring wells. Because of this and since MW33 is screened at the base of the lower aquifer, the occurrence of elevated manganese is likely to be natural. Other metals detected in the "totals" analyses in this were cadmium (1.4 ug/L), chromium (15.4 ug/L), cobalt (6.1 ug/L), thallium (3.8 ug/L) and vanadium (1.8 ug/L). Chromium and thallium were not detected in the "dissolved" analyses, suggesting that the occurrence of these metals was related to particulates from the aquifer, rather than from the groundwater. It is noted that the thallium concentration of 3.8 ug/L in the total metals analysis exceeded the remediation level of 0.2 ug/L listed in the SOW to the ROD.

Due to the low turbidity achieved during low flow sampling (Appendix E), most total metals analyses are directly comparable to dissolved analyses. Aluminum and iron (abundant clay mineral components) appear to be the constituents most variable between total and dissolved groundwater samples.

4.2.4 Tentatively Identified Compounds (TICs)

Several TICs were detected in the volatile (VOC) and semi-volatile (SVOC) analytical results from each of the monitoring wells.

<u>Monitoring Well</u>	<u>Occurrence of TICs</u>	
MW28	VOC	None
	SVOC	One TIC at an estimated concentration of 2 ug/l
MW29	VOCs	One TIC at an estimated concentration of 5 ug/l
	SVOCs	One TIC at an estimated concentration of 3 ug/l
MW30	VOCs	None
	SVOCs	Seven TICs ranging in estimated concentration 5 to 78 ug/l.
MW31	VOCs	None
	SVOCs	Four TICs ranging in estimated concentration 2 to 11 ug/l
MW32	VOCs	None
	SVOCs	Seven TICs ranging in estimated concentration 2 to 25 ug/l.
MW33	VOCs	Six TICs ranging in estimated concentration 6 to 85 ug/l.
	SVOCs	20 TICs ranging in estimated concentration 11 to 62 ug/l.
MW34	VOCs	None
	SVOCs	Six TICs ranging in estimated concentration 3 to 27 ug/l.
MW35	VOCs	None
	SVOCs	Four TICs ranging in estimated concentration 3 to 84 ug/l.
MW36	VOCs	None
	SVOCs	One TIC at an estimated concentration of 2 ug/l

Further information is located in Appendix H, which includes the laboratory analytical results for organic analysis.

ACS PRODUCTION WELLS

5.1 EVALUATION OF PRODUCTION WELLS

There are four active production wells and two abandoned production wells at the ACS site. Information regarding the status of the existing wells and recommendations for abandoning the closed wells was presented in an April 5, 1996 memorandum from Montgomery Watson to U.S. EPA. This memorandum (with a revised "recommendations" section) is included in Appendix J.

The following summarizes the status of each well:

Well No.	Status
IW1	ACS refers to this well as the <i>Reclaim Production Well</i> . All water used from this well is for make-up in a non-contact cooling water system. The well is also available for fire protection, using a booster pump.
IW2	ACS refers to this well as the <i>Boiler Well</i> . When the ACS facility was connected to the public water supply on January 8, 1996, the well was converted to an emergency back-up water supply well. This well was the primary feed well to the main office, and for the boiler system to make steam. Drinking water in the office was treated by a reverse osmosis system.
IW3	ACS refers to this well as the <i>Additives Facility Production Well</i> . Its primary use is for fire protection, using a booster pump. It is also available for minimal process use.
IW4	ACS refers to this well as the <i>Epoxol Well</i> . This well supplies process water in the Epoxol building, and also provides water for employee showers in the locker room. The water is not used as a drinking supply. A water cooler is used in the building to supply bottled water.
IW5 (Abandoned)	ACS estimates that IW5 was taken out of service in the early 1970s. This well is located near the blending facility. The surface exposure is a

two-inch diameter steel or galvanized metal pipe with a threaded cap, sticking up approximately two inches above the ground surface. The PID reading immediately upon removing the threaded cap was 43 ppm. Water was measured at a depth of approximately 3.3 feet below ground surface. During the inspection, an obstruction was encountered 3.5 feet below ground surface. ACS personnel attempted to removed the obstruction but simply pushed it a few inches deeper. Therefore, it was not possible to determine the total depth of the well. Production well IW5 may provide a direct route for contaminants to move from the upper aquifer to the lower aquifer. The well will be further evaluated and then abandoned following U.S. EPA approval of the proposed methodology included in Section 7.2.5 this technical memorandum.

**IW6
(Abandoned)**

ACS estimates that IW6 was taken out of service in the mid 1960s. This well is located just outside the main office building at the ACS facility. The two-inch steel or galvanized pipe sticks up approximately two feet above the ground surface. A threaded cap was removed from the well. No obstructions were encountered in the well. The water level was found to be 3.4 feet below ground surface. The oil/water interface probe used to measure the depth to water did not indicate the presence of oil or free-phase liquid on top of the water. However, the probe had an oily sheen upon withdrawal from the well, indicating the presence of light, non-aqueous phase liquid (LNAPL), or that an oily substance has been placed into the well. Like IW5, production well IW6 may provide a direct route for contaminants to move from the upper aquifer to the lower aquifer. To eliminate the potential of carrying the sheen-material deeper into the aquifer, the probe was not lowered deeper in the well. Upon withdrawal from the well, the probe had accumulated a coating of white residue, where it had bumped against the inside of the casing. The well will be further evaluated and then abandoned following U.S. EPA approval of the proposed methodology included in Section 7.2.5 this technical memorandum.

5.2 PRODUCTION WELL SAMPLING RESULTS

Groundwater samples were collected from the four active production wells on February 6, 1996. Laboratory analytical results are presented in Table 9 and the laboratory analytical reports are included in Appendix K.

VOCs were detected in IW1 and IW4 (Table 9). In IW1, tetrachloroethene (PCE), acetone and 2-butanone were found at concentrations at or above 10 ug/L (10 ug/L in duplicate IW1-91, 14 ug/L and 11 ug/L, respectively), and other VOCs were detected at estimated concentrations less than 10 ug/L. Other detected VOCs included 1,2-dichloroethene (total),

trichloroethene, 1,1,2-trichloroethane, bromoform, 4-methyl-2-pentanone and 1,1,2,2-tetrachloroethane. In IW4, xylene was detected at a concentration of 13 ug/L, and toluene and ethylbenzene were estimated at concentrations of 1 ug/L (J), and 4 ug/L (J), respectively (Table 9). TCE in excess of 5 ug/l would exceed the remediation level. Although PCE is not listed in Appendix B of the SOW, the concentration of 10 ug/l would exceed the MCL for PCE.

VOCs were not detected in water samples collected from IW2 and IW3. Tentatively identified compounds (TICs) were observed in groundwater samples collected from IW1, IW2, and IW4.

5.3 TIME-SERIES SAMPLING OF IW1

A time-series of water samples was collected from production well IW1 during continuous pumping on February 23, 1996. The objective of the time-series sampling was to evaluate how the concentrations of VOCs detected in IW1 (see Section 5.2) behaved during the continuous withdrawal of water from the well. At the start of the time-series test, the pumping rate in IW1 was set at approximately 25 gpm (as measured with a five-gallon bucket). At some time between 120 minutes and 180 minutes, the pumping rate increased to approximately 60 gpm. The reason for the increased pumping rate is unknown, but the higher rate served to increase the volume of water removed between sampling periods.

The following samples were collected during the time-series test:

Sample Time	Time Since Pumping Began (minutes)	Pumping Rate (gpm)	Incremental Volume Removed (gal)	Total Volume Removed (gal)
0835	0 - Start pump	0	0	0
0850	15	25	375	375
0905	30	25	375	750
0935	60	25	750	1,500
1035	120	25	1,500	3,000
1135	180	60*	2,725*	5,725*
1300	265	60	5,100	10,825
1445	370	60	6,340	17,165
1635	480	60	6,600	23,765

* Pumping rate estimated to increase from 25 gpm to 60 gpm at 1100.

Field GC analytical results for the time-series samples are presented in Table 10. PCE and TCE were detected in samples collected up to 60 minutes after pumping was initiated. The concentration of PCE and TCE increased from 15 to 30 minutes, then decreased with additional pumping. TCE was detected last at 60 minutes (5 ug/l) and was not detected during the rest of the test. After 60 minutes of continuous pumping, PCE was detected in the 120-minute, 180-minute, and 480-minute samples at concentrations of 7.4 ug/L, 5.2 ug/L and 5.3 ug/L, respectively. Based on the detection of PCE at 480 minutes near the reporting limits (5 ug/L for the field GC), it is likely that PCE concentrations stabilized at or below the 5 ug/L method reporting limit during the period between 180 and 480 minutes.

The time-series sampling results indicate that the water pumped from IW1 contains low levels (generally <10 ug/l) of TCE and PCE. It appears that the cumulative concentration in water extracted from the well is approximately 5 ug/l. The immediate source of the contamination may be the bedrock aquifer in the vicinity of the open hole. However, the original and probable ongoing source is the upper aquifer, via the well annulus. Once the well is properly abandoned as described herein, this possible source will be eliminated.

PRIVATE WELLS

6.1 PRIVATE WELL SEARCH

In an effort to identify all private wells in the vicinity of the ACS site (as discussed in the Upper Aquifer Technical Memorandum), several sources of information were consulted. The Lake County, Indiana Health Department and the Griffith Public Works Department were contacted for information on wells in the area, and well logs were obtained from the Indiana Department of Natural Resources (IDNR).

The well search built on the well location information presented in the RI report and Upper Aquifer Technical Memorandum. It was prepared by Environmental Data Resources, Inc. (EDR, a commercial database service. Well locations were plotted from an August 1996 water well records list obtained by Montgomery Watson from the Indiana Department of Natural Resources (IDNR). EDR combined several well locations under a single well symbol in areas of the map that contained many wells. The EDR data base is included in Appendix L. To facilitate viewing, the multiple well locations in the direct vicinity of the ACS Site have been hand plotted to show the separate well locations. During the Lower Aquifer Investigation, Montgomery Watson conducted a door-to-door survey of residential and industrial properties along Colfax Avenue, South Arbogast Avenue, and Reder Road to identify wells that were not included in the IDNR data base. Identified wells were hand-plotted and shown on the Well Search Map (Figure 8). Table 11 lists these field identified water wells.

The Lake County Health Department does not have information on private well locations. According to the Griffith Public Works Department, ACS and the Griffith Public Works Garage have been connected to the municipal water system. Water main locations were obtained from the Town of Griffith Public Works Department and are plotted on Figure 8 to provide an indication of areas that may use private wells. Other homes and businesses along South Colfax Avenue and Main Street in the vicinity of ACS, and along Reder Road, Arbogast, and Avenue H have not been connected to municipal water, and are therefore served by private wells. It appears that most of the residential and business districts north and west of the ACS facility are supplied water by the Griffith municipal supply.

Based on the dimensions of the VOC plume in the upper aquifer, these well locations may have been susceptible to potential VOC migration along the well casing from the upper to lower aquifer. Two of the wells are located within the area of identified upper aquifer contamination (well numbers 5 and 13 on Table 11; Figure 8), and two wells are located outside the zone but near the zone of contamination (well numbers 15 and 17 on Table 11; Figure 8). Water samples from the four wells were analyzed for full scan TCL/TAL list.

Because other private wells identified in the area are located beyond the limits of upper aquifer contamination presented in the Upper Aquifer Technical Memorandum, other wells were not included in the sampling plan at this time.

6.2 PRIVATE WELL SAMPLING RESULTS

Residential wells were sampled on July 17, 1996 for VOCs, semi-volatile compounds, PCBs and metals. Split samples were collected from each residential well by a U.S. EPA representative. Laboratory analytical results for VOCs and SVOCs are presented in Table 12. Metals results are summarized in Table 13. Laboratory analytical reports from IEA for VOCs, semi-volatile compounds and PCBs are included in Appendix M, and laboratory analytical reports for metals are included in Appendix N. Groundwater samples collected for semi-volatiles and PCBs from residential well PW01 (1002 Reder Road) were lost during shipment by Federal Express. Therefore, results from PW01 for semi-volatiles and PCBs are not available.

Residential well sample identification numbers correspond with the following addresses:

<u>Well Identification</u>	<u>Address</u>
PW01	1002 Reder Road
PW02	938 Arbogast
PW03	940 Arbogast
PW04	430 East Avenue H

6.2.1 VOCs

Chloroethane (21 ug/L) and benzene (1 ug/L) were detected in private well PW02. No VOCs were detected in the other three wells sampled: PW01, PW03, or PW04 (Table 12). The residence at PW02 is connected to the Town of Griffith water supply and therefore, the well that was sampled is not used as a drinking water well.

6.2.2 Semi-Volatile and PCB Results

Bis(2-ethylhexyl)phthalate was detected in the sample collected from PW03 at a concentration of 12 ug/l. The occurrence of this compound is considered to be laboratory related. Several semi-volatile tentatively identified compounds (TICs) were detected in PW02 (20 TICs) and PW03 (5 TICs). No PCBs were detected. The semi-volatile analytical results are summarized on Table 12.

6.2.3 Inorganic Results

Groundwater samples from the residential wells were analyzed for total and dissolved metals (Table 13). Major groundwater constituents, calcium, magnesium, and sodium, were detected at the highest concentrations in the residential wells, followed by detections of minor constituents barium, copper, iron, manganese, and potassium (Table 13). Other metals were generally not detected or found below quantitation limits ("B" designation on Table 13).

The highest metal concentrations were observed in PW02 (938 Arbogast). Several total and dissolved constituents were found in this well at levels considerably higher, depending on constituent, than the other three wells. The highest concentrations were associated with the major constituents calcium, magnesium, sodium, and potassium. Other constituents such as nickel (51 u g/L) and silver (10.5 ug/L) were not detected in the other three wells. The residence at PW02 is connected to the municipal water supply so this well is not used as a drinking water source.

Total and dissolved metals concentrations generally are comparable. Barium, calcium, iron, magnesium, manganese, potassium, and sodium appear to be the constituents most comparable between total and dissolved metal concentrations.

CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

Lower Aquifer Investigation activities implemented during January, February and March 1996 at the ACS NPL site consisted of the following:

- Using a rotosonic drilling method to obtain continuous core samples to evaluate the stratigraphy of the lower aquifer;
- Vertical profiling across the lower aquifer at four locations, and field GC analysis of groundwater samples for target VOCs, to detect any zones of VOC contamination in the lower aquifer;
- Installation of nine monitoring wells and three piezometers in the lower aquifer at six locations;
- Sampling of nine new lower aquifer monitoring wells for full scan TAL/TCL (VOCs, semi-volatiles, PCBs, and metals);
- Measurement of water levels in the new wells and piezometers in the lower aquifer to determine horizontal and vertical gradients;
- Measurement of continuous water levels in two monitoring wells and one piezometer for approximately 30 days;
- Evaluation and sampling of current ACS production wells for VOCs;
- Chemical time-series sampling of ACS production well IW1 and analysis with the field GC;
- Inspection of two abandoned ACS production wells;
- Identification of private residential wells within a 2-mile radius of the ACS facility

The following conclusions are based on the data developed from these activities:

1. The stratigraphy of the unconsolidated aquifers at the ACS site consists of upper and lower sand aquifers separated by a clay confining layer.
2. The upper clay confining layer varies in thickness from 35 feet to the south to four feet to the north. The top of the clay is found at elevations between 618 and 622 feet amsl on site.
3. The lower aquifer was determined to consist of well sorted gray to brown fine sand which varies in thickness at the ACS site between 40 to 68 feet. Delineation of lower aquifer stratigraphy meets Objective #1 established for the Lower Aquifer Investigation
4. The lower clay confining layer was found to be 12 to 20 feet thick at an elevation between 540 and 550 feet amsl at two locations. Bedrock consists of dark gray shale at an elevation of 527 to 538 feet amsl.
5. The vertical hydraulic gradient in the lower aquifer was less than or equal to 0.001 from upper to lower portions of the aquifer, as indicated by water levels collected at lower aquifer monitoring wells and piezometers on March 15, 1996.
6. The direction of groundwater flow in the lower aquifer is northward under a hydraulic gradient of 0.00047. The horizontal gradient ranges from 1.5 to more than five times the vertical gradients in the lower aquifer. The direction of groundwater flow and hydraulic gradient are consistent with those for the June 1991 RI and the October 1995 Technical Memorandum. Determination of horizontal and vertical gradients meets Objective #4 set forth in the SOW for the Lower Aquifer Investigation.
7. Although potential VOC contaminants were indicated by the vertical profiling at two lower aquifer points (MW8, MW10), it was not confirmed by the sampling of monitoring wells that were installed at these points. The elevated PID readings observed in the upper portion of the lower aquifer indicated the potential for contamination at the MW10 location. Installation of a new lower aquifer monitoring well is proposed at the MW10 nest to address this potential for contamination. The new well will replace existing monitoring well MW10 in the Monitoring Plan.
8. Bis(2-ethylhexyl)phthalate was detected in samples collected from MW29, MW30, MW32, and MW35 at concentrations ranging between 11 ug/L and 68 ug/L. No other semi-volatiles or PCBs were detected above quantitation limits in monitoring well samples.

9. Major groundwater inorganic constituents (calcium, magnesium, sodium, iron, and potassium) were detected at the highest concentrations in the samples from the lower aquifer. Chromium and thallium were detected in the "totals" analyses at the base of the lower aquifer in monitoring well MW33, but these metals were not detected in the "dissolved" sample analyses. Other metals were generally not detected, found below quantitation limits, or were below the remediation levels listed in the SOW to the ROD.
10. The detection of only trace levels (estimated 2 ug/L) of chloroethane at MW29 indicates that the zone of known contamination indicated at MW9 in the RI, extends to a depth of approximately 60 feet in the lower aquifer (vertical gradient component of Objective #3).
11. Elevated PID readings just below the base of the confining clay (613 ft amsl) to approximately 10 ft into the lower aquifer (603 ft amsl) at the MW10 location may indicate the presence of constituents in the lower aquifer at this downgradient location.
12. A zone of upper aquifer contamination was better delineated during the Upper Aquifer Investigation. Chloroethane and benzene were detected at levels below remediation levels and MCLs at private well PW02, which appears to be drilled through the zone of upper aquifer contamination. An additional lower aquifer well will be installed downgradient of the PW02 location to evaluate the lower aquifer in this area.
13. Although NAPLs are known to exist in the upper aquifer, the findings of the lower aquifer investigation did not provide evidence for the presence of DNAPLs in the lower aquifer (Objective #5). The presence of DNAPLs might have been indicated by either: 1) observations of DNAPL during coring, vertical profiling or monitoring well sampling; or 2) detections of elevated concentrations of contaminants during groundwater sampling in the lower aquifer (resulting from dissolution of DNAPL product into the groundwater). The presence of a sheen was observed during the inspection of IW6, may indicate the potential for the presence of LNAPLs.
14. VOC concentrations approximately 14 ug/L were found in lower aquifer water samples collected from two ACS production wells.

7.2 RECOMMENDATIONS

7.2.1 Horizontal Extent Downgradient of Site

Elevated PID readings observed below the confining clay at the monitoring well MW10 location indicate the potential for contamination in the lower aquifer. No well was installed at this depth during the investigation because MW10 was screened from 10 to 15 ft below

the confining clay layer. A new monitoring well is proposed at this location, with a ten-foot screen across the portion of the lower aquifer (613 ft to 603 ft amsl) where the elevated PID readings were observed.

The monitoring well will be constructed in accordance with the Statement of Work (SOW) and Specific Operating Procedures (SOPs) approved for the previously installed lower aquifer monitoring wells. The new well will replace existing monitoring well MW10 in the quarterly monitoring program to provide ongoing confirmation of compliance, or provide an indication of future contaminant migration.

7.2.2 Vertical Extent at the MW9 Well Nest

The detection of a trace level of chloroethane at MW29 (2 ug/L) in the March 1996 sampling (Appendix H), indicates that MW29 is positioned at the lower extent of contamination in the lower aquifer. Therefore no further investigation or monitoring well installations are recommended at this location. Monitoring wells MW9 and MW29 will be included in the quarterly monitoring program to provide future indications of compliance or contaminant migration in the lower aquifer at this location.

7.2.3 Character of Lower Aquifer Contamination

The nature of the contamination in the lower aquifer at the site has been defined to date by the chloroethane detected at monitoring well MW9, chlorinated ethenes and xylenes detected in the samples from the ACS production wells IW1 and IW4, and the oil sheen observed in production well IW6.

There have been previous discussions with the U.S. EPA regarding the viability of installing additional lower aquifer wells within the ACS boundaries. Given the very high levels of contamination and the presence of non-aqueous phase liquids (NAPLs) within the site boundaries, and given the strong downward gradient between the upper and lower aquifer, we believe that any decision regarding installation of new lower aquifer wells within the Site boundaries should be deferred until after the upper aquifer groundwater treatment systems are in place and operational. When the treatment systems are operational, the highly contaminated areas will be dewatered and the dewatering will eliminate the strong downward gradient from the upper to the lower aquifer.

7.2.4 Potential Lower Aquifer Contamination in the Vicinity of Plume to Southeast

During the Upper Aquifer Investigation, samples were analyzed by field GC as an indicator of the extent of the plume in the upper aquifer extending south-southeast from the intersection of Reder Road and Colfax Avenue. Upper aquifer monitoring wells have been installed to confirm the extent of this plume and to monitor its future behavior. A new lower aquifer well will be installed downgradient of the PW02 location to evaluate the lower aquifer 100 to 200 feet north of PW02. The monitoring well will be constructed in accordance with the Statement of Work (SOW) and Specific Operating Procedures (SOPs) approved for the previously installed lower aquifer monitoring wells. The monitoring well will be included in the quarterly monitoring program to provide ongoing confirmation of compliance, or provide an indication of future contaminant migration.

7.3 ACS PRODUCTION WELLS

Investigation and sampling results indicate that four active production wells (IW1, IW2, IW3, and IW4) and the two closed production wells (IW5 and IW6) may present migration routes for contaminants between the upper and lower aquifers. Therefore, after further investigations, the six production wells will be abandoned in accordance with the Indiana Administrative Code regarding well abandonment, 310 IAC 116-10-2.

7.3.1 Production Wells IW1, IW2, IW3, and IW4

The pump, the piping, and the wiring will be removed from the each well. Then the following investigations will be conducted at each of the four well locations.

7.3.1.1 Sounding Measurements

Total Depth. After the pumps have been removed, the total depth of each well will be measured with a steel tape or well sounding device. It is possible that obstructions will be encountered in the open hole portion of the well. In such a case, the total depth to the obstruction will be measured.

Static Water Level. It is expected that the water levels in the production wells will be representative of the bedrock aquifer. Water levels will also be collected in monitoring wells MW7, MW8, and MW9 to represent the lower alluvial aquifer, and in piezometers P29 P32, and P35 to represent the water table aquifer. Water levels will also be collected from IW5 and IW6 discussed below.

All the water levels will be collected within a four-hour time span to provide concurrent water levels in the bedrock aquifer, the lower alluvial aquifer, and upper alluvial aquifer. Water levels will be measured and recorded for each of the four production wells. The reference elevation (top of casing), will be established to within 0.01 foot by a surveyor so that the water levels can be translated into groundwater elevation in feet above mean sea level.

7.3.1.2 Well Logging

Caliper Log. A caliper log will be used primarily to identify the end of the casing and beginning of the open hole in the bedrock. It may be that the open hole below the casing is not a clean cylindrical borehole. The rock may be highly fractured, differentially enlarged, or obstructed. Therefore, caliper log will also be useful in determining the practicality and methodology for logging the entire well from the base of the open hole up through the casing.

Natural Gamma Log. The objective of using the natural gamma log will be to identify the depths of the transitions and the thicknesses of the upper aquifer, the upper confining clay layer, the lower alluvial aquifer, the lower confining clay layer, and the bedrock. Assuming that the caliper log indicates logging the open borehole will be practicable, the natural gamma log will also be used to log that portion of the well.

7.3.1.3 Sampling

The four active production wells, IW1, IW2, IW3, and IW4 were sampled during the lower aquifer investigation in February 1996. The samples collected from IW1 contained low concentrations of PCE and TCE. The sample collected from IW4 contained low levels of toluene and xylenes. (VOCs were not detected in wells IW2 and IW3). We do not believe that these concentrations are representative of the contamination in the bedrock aquifer. Rather, we suspect that the source of the VOC contamination is leakage from the upper aquifer, along the annulus of the well, or possibly from the well pumping system itself.

The most likely entry point for the contaminants is at the base of the casing where it is seated in the bedrock (a depth of 131 feet according to the available well log). The samples were collected by the pumps which exist within the wells, after purging several hundred gallons from each well. The sample results are representative of the average quality of the bedrock aquifer, plus whatever is leaking down the annulus of coming from the pumping system. The sampling results may not be representative of what is leaking down the annulus into the bedrock aquifer.

The following low flow sampling technique will be used to collect samples of water from the discrete interval where the casing is seated in the bedrock:

- A submersible pump will be lowered to the target depth indicated by the caliper log.
- Ten gallons of water will be purged from the well, with the pump operating at normal speed (3 - 5 gpm).
- The pumping rate will be restricted to 200 ml/minute, and then the pump will be turned off and left in place for 15 minutes.
- The total number of milliliters in the hose between the pump and the ground surface will be calculated, to determine how many minutes of pumping will be required to bring a discrete sample from the target depth, to the surface.
- After 15 minutes of quiescence, the pump will be turned on at 200 ml/minute and pumped for the calculated time.
- Two samples will be collected for TCL and TAL analyses. One sample volume will be provided to the U.S. EPA as a split sample. The other will be submitted to the laboratory for analysis by Montgomery Watson.

This sampling process will be conducted at each of the ACS wells drawing water from the bedrock aquifer. Upon completion of the sampling the wells will be abandoned in accordance with Indiana guidance regarding water well abandonment, 310 IAC 16-10-2.

7.3.1.4 Abandonment

The detection of low levels of VOCs in samples from two of the ACS bedrock wells indicate that the wells are acting as conduits from the upper aquifer to the deeper aquifers. To eliminate the potential for future contaminant migration along the well casings, the four ACS wells will be abandoned. The concept of the abandonment includes sealing the open hole in the bedrock by filling it with grout, and then sealing the annulus of the well in the most vulnerable zone. The most vulnerable zone is from the base of the upper clay layer, approximately 20 feet down into the lower aquifer. The abandonment will be conducted in the following steps:

- A tremie pipe will be lowered as far as possible into the well. Assuming that there are no obstructions, this will be to the bottom of the open borehole in the bedrock.
- Grout will be injected from the bottom of the borehole via the tremie, filling the open hole and bringing the grout up into the casing to within 40 feet of the base of the upper clay.
- The rig will move on to the next well, allowing the injected grout to set up.
- When the grout has set up in the lower part of the well, a perforating tool will be lowered into the casing, to make 10 perforations, approximately 1/2 inch in diameter, through the casing just above the grout. The perforations will be made around the circumference of the casing, along approximately a two-foot length.
- Another similarly arrayed set of 10 perforations will be made two to four feet above the base of the upper clay confining layer.
- A packer will be placed down the well and expanded to seal it just above the lower set of perforations.
- Water will be injected into the packed-off section of the casing. Flow of water through the upper perforations will demonstrate continuity in the zone to be grouted. If water flow is not induced, the packer will be withdrawn and more perforations will be made. Then the packing and water injection will be repeated.
- When water flow demonstrates continuity, a grout mixture will be injected through the packed-off zone, until the consistency of the returned grout indicates that full strength grout has filled the annulus between the two sets of perforations.
- The rig will move on to perforate and grout the remaining wells.
- The rig will return to the first location and fill the remaining casing with grout, and cap it in accordance with 310 IAC 16-10-2. These steps will be repeated at each of the remaining bedrock production wells.

7.3.2 Closed Production Wells IW5 and IW6

Production wells IW5 and IW6 were closed by ACS Inc., by extending the existing two-inch casings above ground surface and capping. The static water levels in both IW5 and IW6 is approximately 3.5 feet below ground surface. Well IW5 has an obstruction approximately 5 feet below ground surface. A sheen on the water level probe inserted into well IW6 indicates the presence of a free-phase liquid.

The obstruction in IW5 is partial, in that it does not block the movement of liquids. The first step in the investigation of IW5 will be to use fishing tools to try to remove the obstruction. With the presence of a work-over rig on site, more finesse and more force can be brought to bear than previously to clear the obstruction. The first step in further investigating IW6 will be to lower a transparent bailer below the water surface and draw it out to determine if there is floating free-phase product in the well.

7.3.2.1 Level and Depth Measurements

As described in section 1.1.2, the static water levels will be measured in each well, IW5 and IW6. In addition, the total depth of each well will be measured (assuming that the obstruction has been cleared from IW5).

7.3.2.2 Well Logging

The natural gamma log will be used to provide an indication of the depth to and the total thickness of the clay confining layer between the upper and lower aquifer. If it is not possible to clear the obstruction from IW5, it will not be possible to perform the natural gamma log.

7.3.2.3 Sampling

The total volume of each casing will be calculated from the results of the depth measurements. Two casing-volumes of water will be bailed from each well. The water will be bailed from the top five feet of the casing, to draw fresh water in from the bottom of the casing. (Even if it has not been possible to remove the obstruction from IW5, this method will still allow purging and sampling of the well.)

After purging two casing volumes from the well, sample volumes of the water from IW5 and IW6 will be collected for laboratory analysis of the Target Compound List (TCL) organics. Additional sample volumes will be provided to U.S. EPA for a split sample. Since the obstruction is approximately five feet below ground surface in IW5, this procedure will allow sampling even if it has not been possible to remove the obstruction.

7.3.2.4 Abandonment of IW5 and IW6

After samples have been collected, IW5 and IW6 will be permanently abandoned by the following methods.

Over drilling and Grouting. The existing two-inch casing will be overdrilled by a drilling rig equipped with a 10-inch inside diameter hollow-stem auger. The casing will be overdrilled to a depth of at least two feet into the confining clay layer between the upper

alluvial and lower alluvial aquifer. The depth to and thickness of the clay will have been determined by the natural gamma logging. The augers will be withdrawn from the borehole, and the borehole will be filled from the bottom with grout. The rig will move on to the next location, while the grout sets up.

Remove Existing Casing

Upon overdrilling well at the second location, the rig will return to the first location and pull the two-inch casing out of the hole. The casing will be steam cleaned and disposed of as scrap metal.

Grout to Surface

A tremie pipe will be lowered as far down into the clay confining layer below the casing as possible and the eight-inch casing will be filled from the bottom with grout. Groundwater that overflows as the hole is filled with grout will be placed in drums and allowed to settle. After grout and particulate matter has settled out, the water will be processed through the construction de-watering water treatment system.

After the first of the two casings has been grouted, the rig will move on and perform the same abandonment procedure on the second well

7.4 LOWER AQUIFER MONITORING PLAN

Water level measurements in the lower aquifer indicate a consistent horizontal gradient almost directly to the north. On the basis of the hydraulic gradient and the hydraulic conductivity calculated during the RI, the groundwater flow rate is 50 to 70 feet per year to the north. The horizontal gradient has been consistent without apparent seasonal effects. Given this flow velocity, quarterly sampling would collect samples each time the groundwater flow in the lower aquifer advances 12 to 18 feet.

7.4.1 Water Level Measurements

Water levels will be collected at each well in the upper aquifer monitoring plan (to be submitted) and in each lower aquifer monitoring well and piezometer, prior to sampling any of the wells. All the water levels should be collected in a single day to minimize the potential water variability with time.

7.4.2 Baseline Sampling

A lower aquifer water quality baseline will be established by sampling 19 lower aquifer wells for four consecutive quarters starting in October 1996. The first "round" of sampling for the baseline will consist of the full-scan sampling of the new lower aquifer wells in March, the residential well sampling in July, and the proposed sampling of the previously existing lower aquifer wells in October. The proposed locations and parameters are summarized in Table 14.

During the first year (March and October 1996 combined) and the third quarter of the second year (1997) samples from one upgradient well (MW22) and 16 downgradient wells will be analyzed for full-scan Target Compound List (TCL) and Target Analyte List (TAL) parameters. Water samples from two additional monitoring wells located side gradient to the site (MW21 and MW7) will be analyzed for TCL parameters.

Samples will also be collected during the interim second and third quarters, and laboratory analyzed for compounds in a Target Indicator List (TIL). The target compounds will include those that have consistently been detected in the contaminant plume (benzene, chloroethane, ethylbenzene, toluene, xylene, chlorobenzene, 1,2-dichloroethene, and 1,1-dichloroethane). Field parameters, including pH, and conductivity will be measured and recorded.

The preliminary sampling schedule is also provide for 1998. It shows a list of wells and parameters to be completed. A revised list would be developed and proposed to U.S. EPA from a review and analysis of the baseline results. The revised plan will include the rationale for each on-going sampling point, presenting the rationale for changes in the locations, frequency, and parameters for the sampling program.

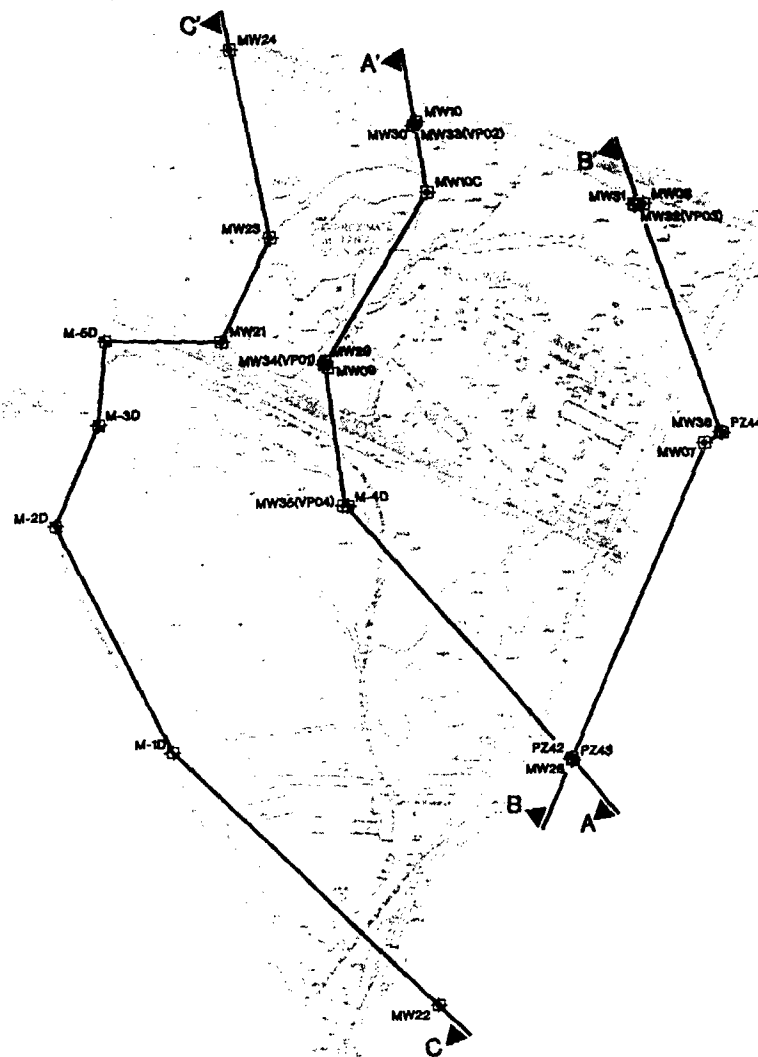
7.4.3 Residential Well Drinking Water Sampling

Up to three residential drinking water wells will be sampled annually as part of the lower aquifer monitoring program. PW01, the closest private well to the site, located at 1002 Reder Road will be included in the sampling each year. The other two locations may be the same locations each year, or may be new designated wells each year. Recommendations regarding the locations and analytical parameters will be made each year, on the basis of the results of the ongoing monitoring program.

KJS/PJV/PRP

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LEGEND

- MW07 LOWER AQUIFER MONITORING WELL LOCATION AND NUMBER
- MW28 NEW LOWER AQUIFER MONITORING WELL LOCATION AND NUMBER
- PZ43 LOWER AQUIFER PIEZOMETER LOCATION AND NUMBER
- M-30 GRIFFITH LANDFILL LOWER AQUIFER MONITORING WELL LOCATION AND NUMBER
- (VP08) VERTICAL PROFILE BORING LOCATION AND NUMBER
- A CROSS SECTION LOCATION LINE

NOTES

1. BASE MAP DEVELOPED FROM AN AERIAL SURVEY MAP OF THE SITE FLOWN ON MARCH 8, 1994 BY GEONEX CHICAGO AERIAL SURVEY, INC. CONTOUR INTERVAL IS TWO FEET.
2. ELEVATIONS ARE BASED ON U.S.G.S. DATUM (MEAN SEA LEVEL).
3. GRID BASED ON INDIANA STATE PLANE COORDINATE SYSTEM.
4. MONITORING WELLS MW28 THROUGH MW36 AND PIEZOMETERS PZ42 THROUGH PZ44 INSTALLED DURING FEBRUARY, 1996 BY BOART LONGYEAR, INC. UNDER SUPERVISION OF MONTGOMERY WATSON. SEE RI REPORT FOR INSTALLATION INFORMATION FOR MONITORING WELLS MW07 THROUGH MW10 AND MW17. MONITORING WELL M-10 THROUGH M-50 OWNED BY GRIFFITH LANDFILL.
5. LOCATION OF MONITORING WELLS MW28 THROUGH MW36 AND PIEZOMETERS PZ42 THROUGH PZ44 BASED ON SURVEY CONDUCTED BY AREA SURVEY, CO., DURING MARCH, 1996.



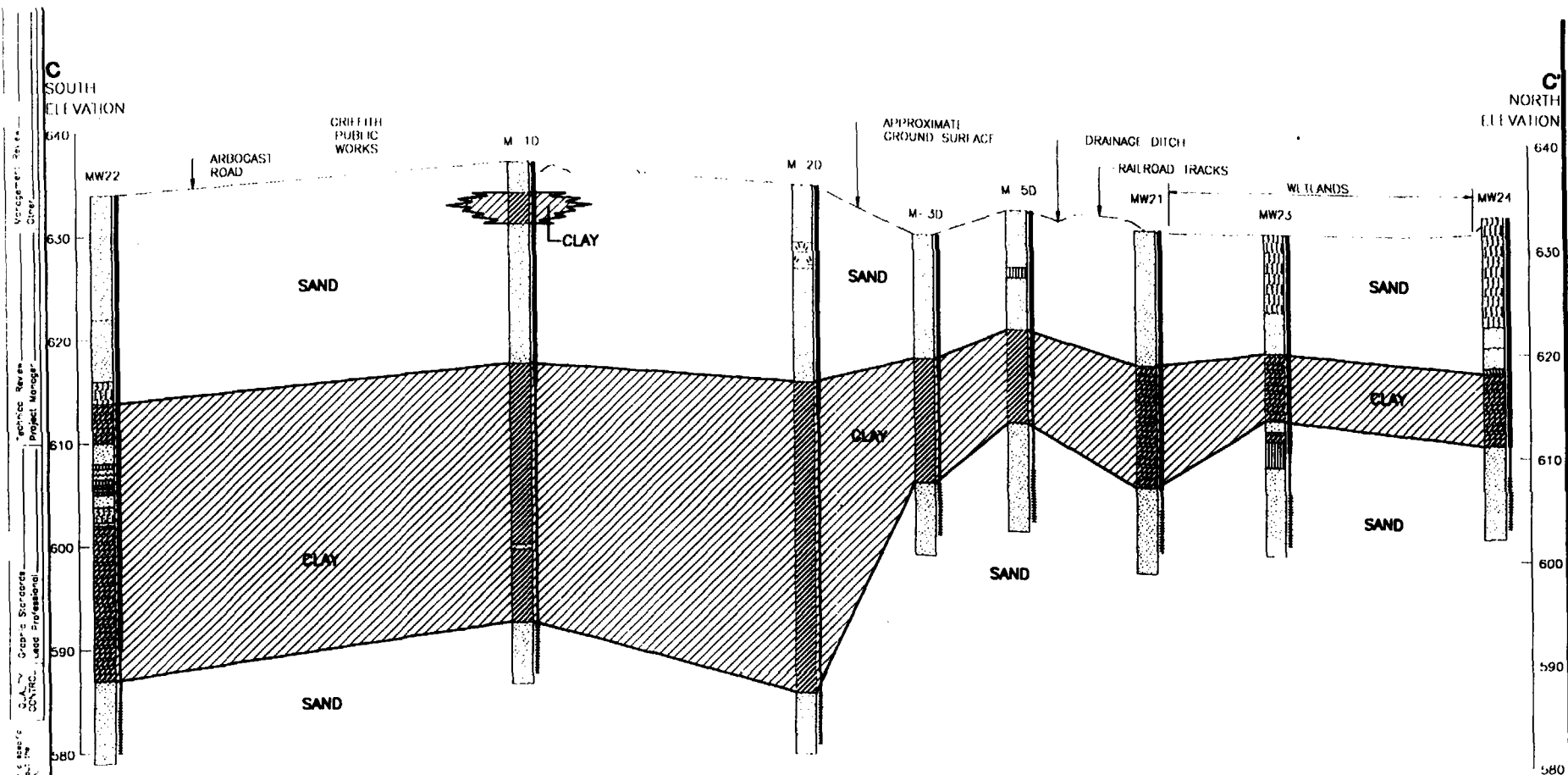
FIGURE 2

Developed By	RJR	Drawn By	DLF/LCL
Approved By	PJV	Date	8/15/96
Reference			
Revision			

CROSS SECTION LOCATION MAP
LOWER AQUIFER INVESTIGATION
AMERICAN CHEMICAL SERVICE
NP SITE
GRIFFITH, INDIANA

Drawing Number
4077.0076 B2

MONTGOMERY
WATSON

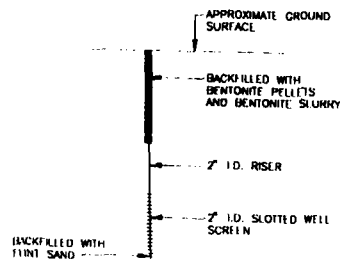


LEGEND

- SAND, WITH LOW SILT AND CLAY CONTENT (SP)
- SILTY SAND (SM)
- SAND AND GRAVEL WITH LOW SILT AND CLAY CONTENT (SP/GP)
- SILT (ML)
- LEAN CLAY (CL)
- SILTY CLAY (CL-ML)
- SHALE

NOTES

1. THE STRATUM LINES ARE BASED ON INTERPOLATION BETWEEN BORINGS AND MAY NOT REPRESENT ACTUAL SUBSURFACE CONDITIONS.
2. REFER TO FIGURE 1 FOR ADDITIONAL NOTES.
3. CROSS SECTION LOCATIONS ARE SHOWN ON FIGURE 2.
4. FOR THE PURPOSE OF ILLUSTRATING SUBSURFACE CONDITIONS ON THE CROSS SECTION, SOME OF THE BORING LOGS HAVE BEEN SIMPLIFIED FOR A DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT INDIVIDUAL BORINGS, REFER TO SOIL BORING LOGS, APPENDIX A OF TEXT.
5. FOR COMPLETE MONITORING WELL INSTALLATION DETAILS REFER TO APPENDIX C OF TEXT.
6. HORIZONTAL DISTANCES ARE MEASURED WITH RESPECT TO THE CENTER OF EACH SOIL BORING LOCATION.
7. EXISTING GROUND SURFACE WAS TAKEN FROM FIGURE 1.
8. ELEVATIONS ARE SHOWN IN REFERENCE TO U.S.G.S. DATUM.
9. QUESTION MARKS AT THE CONTACTS BETWEEN SUBSOIL TYPES INDICATES THE CONTACTS ARE INFERRED.
10. WELL LOG INFORMATION OBTAINED FROM ATC TRAFFIC, INC., INDIANAPOLIS, INDIANA, FOR CITY OF GRIFFITH, INDIANA.



TYPICAL WELL INSTALLATION DETAIL

NOT TO SCALE

CROSS SECTION SCALE



SCALE IN FEET
VERTICAL EXAGGERATION: THIRTY TIMES

FIGURE 4A

CROSS SECTION C-C'

Drawing Number
4077.00/6 B6
MONTGOMERY
WATSON

A



A1

EXISTING MONITORING WELLS,
GRIFFITH LANDFILL WELLS,
AND CLAY BORING CB-1

**MONTGOMERY
WATSON**

LOG OF TEST BORING

Project American Chemical Service, Inc.
RI/FS Phase II
 Location Griffith, Indiana

Boring No. MW07
 Well No. MW07
 Sheet 1 of 2
 Surface Elevation 638.7
 Northing: 6732.0
 Easting: 6113.0

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

SAMPLE					SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID	Depth (ft.)				
		1	0.4	5		Vegetated Surface Near Marsh, Brown to Gray Fine SAND		
		2	0.1	10		Grades into Gray, Fine to Coarse SAND, Trace to Some Fine Gravel, Trace Pebbles, Wet (SP) At 9' grades into Gray Fine SAND, Well to Medium Sorted, Trace Fine Gravel, Wet (SW)		Rust Color at 5-6'
		3	0.0	15		Grades into Dark Gray, Fine to Medium SAND, Trace to Some Silt, Trace Clay, Increased Silt and Clay at 18.5'		
		4	3.0			Decreased Medium Sand and Gravel, Trace Thin (1/2") Silty Clay and Clayey Silt Layers		
		5	0.8	20		Grades to Gray, Silty, Fine SAND to 20.5' (SP-SM)		
		6	0.0			Gray, Silty CLAY, Trace to Some Fine SAND, Trace Interbedding of Clay and Silt (CL)		Set 6" Permanent Casing to 21'
		7						
		8	0.0	25				
		9	0.0			Decreased Silt and Sand, Trace Fine Gravel at 27'		
		10	0.0	30				
		11	0.0			Becomes Very Dense and Slightly Gravel at 32'		
		12	0.0					
		13	0.0	35		Trace Fine Sand at 35'		
		14	0.0					
		15	0.0	40		Gray, Fine to Coarse SAND, Some Gravel,		

GENERAL NOTES

Start 3/7/90
 End 3/14/90
 Driller ETI
 Rig D-50

Logger TJM
 Editor
 Chief KKT
 Drill Method 4 1/4" I.D. HSA (0-21'); RWB (21-50')

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

**MONTGOMERY
WATSON**



LOG OF TEST BORING

Project American Chemical Service, Inc.
RI/FS Phase II
 Location Griffith, Indiana

Boring No. MW07
 Well No. MW07
 Sheet 2 of 2
 Surface Elevation 638.7
 Northing: 6732.0
 Easting: 6113.0

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

SAMPLE

Run No.	TYPE	Sample No.	PID	Depth (ft.)
		16	0.0	
		17	0.0	45
		18	0.0	50
				55
				60
				65
				70
				75
				80
				85

SOIL GRAPHIC

VISUAL CLASSIFICATION

WELL DIAGRAM

REMARKS

Trace to Little Silt and Pebbles (SP-SM)

Grades to Dark Gray, Poorly Sorted, Medium SAND, Trace to Some Fine Sand, Trace Coarse Sand and Fine Gravel and Silt, Occasional Limestone Pebbles, Wet Increased Fine Sand and Coarse Shale Gravel at 45' (SP-SM)

No Odor

End of Boring at 50.0 ft
 Install Monitoring Well at 47.8 ft

MONTGOMERY WATSON



LOG OF TEST BORING

Project American Chemical Service, Inc.

RI/FS Phase II

Location Griffith, Indiana

Boring No. MW08

Well No. MW08

Sheet 1 of 2

Surface Elevation 638.2

Northing: 7506.0

Easting: 5934.0

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

SAMPLE					SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID	Depth (ft.)				
						Vegetated Sandy Surface Black Sandy Loam to Brown Fine SAND, Trace Silt (SM)		
		1	0.0	5		Brown to Gray Fine SAND, Trace Fine Gravel (SP-SM)		No Odor
		2	6.0	10		Trace Medium Sand and Fine to Coarse Gravel (SP), Wet		Very Slight Odor at 10'
		3	22.0	15		Becomes Gray to Dark Gray, Fine to Coarse SAND, Trace Fine to Coarse Gravel (SP)		
						Trace Silty Clay at 17'		Slight Odor and Dark Staining at 16'
		4	0.2	20		At 18', Grades to Gray, Silty, fine SAND, Trace Gray Silty Clay and Fine Gravel (SM)		
		5	1.0			Dense, Gray, Silty CLAY, Trace Fine Gravel (CL-ML)		Set 6" Permanent Casing to 22.5'
		6	0.0	25		Gray, Fine to Coarse SAND, Trace to Some Silt (SM)		
		7	0.0			Very Dense, Gray, Silty CLAY, Trace Fine to Medium Gravel (CL-ML)		
		8	0.0	30		Decreased Silt at 30'		
		9	0.0			Gray, Fine to Coarse SAND, Some Gravel (GP)		
						Gray, Fine SAND, Trace Silt and Medium Sand, Well Sorted, Wet (SM)		
		10	0.0			Gray, Silty CLAY and Clayey SILT (Interbedded), Trace to Some Fine Sand (CL-ML)		
		11	0.0	40				

GENERAL NOTES

Start 3/9/90
End 3/16/90
Driller ETI
Rig D-50

Logger TJM
Editor
Chief KKT
Drill Method 4 1/4" I.D. HSA

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

MONTGOMERY WATSON



LOG OF TEST BORING

Project **American Chemical Service, Inc.**
 Location **RI/FS Phase II**
Griffith, Indiana

Boring No. **MW08**
 Well No. **MW08**
 Sheet **2 of 2**
 Surface Elevation **638.2**
 Northing: **7506.0**
 Easting: **5934.0**

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

SAMPLE					SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID	Depth (ft.)				
		12	0.0			Gray, Silty, Fine SAND, Trace Clay and Silt (laminated) (SM)		
		13	0.0	45		Gray, Silty CLAY, Trace Fine Sand (CL-ML)		
						Gray, Silty, Fine SAND and Sandy SILT, Trace Clay (SM-SC)		
						Gray, Very Silty, CLAY Layer (CL-ML)		
				50		Gray, Fine SAND, Trace Medium Sand and Fine Gravel (SP)		
						At 44', Gray, Fine to Coarse SAND, with 2" Fine to Coarse Gravel Layer		
				55				
				60				
				65				
				70				
				75				
				80				
				85				

End of Boring at 47.0 ft
 Installed Well to 45.0 ft

**MONTGOMERY
WATSON**

LOG OF TEST BORING

Project American Chemical Service, Inc.
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW09
Well No. MW09
Sheet 1 of 1
Surface Elevation 635.9
Northing: 6990.0
Easting: 4893.0

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

SAMPLE					SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID	Depth (ft.)				
						Vegetated Surface Underlain by 1.5' of Black Sandy Loam		
		1	0.0	5		Brown and Gray Fine SAND, Trace Silt (SM)		
		2	2.5	10		At 10.3' Becomes Dark Gray to Gray, Silty, Fine SAND, Trace to Little Clay and Fine Gravel (SM), Grades to Gray Fine SAND, Trace Silt and Fine Gravel (SP-SM)		Very Slight Odor at 11'
		3	0.4	15				
		4	0.0			Dense, Gray, Silty CLAY, Trace Fine to Medium Sand and Gravel (CL-ML)		
		5	2.0	20		Thin Clayey, Fine to Coarse Sand Seam (1/2") at 19.2'		Set 6" Permanent Casing at 18.5'
		6	2.0					
		7	2.5	25				
		8	2.0			Dark Gray and Black, Fine SAND, Trace Medium Sand, Wet with Slight Odor (SP-SM)		
		9	2.0			At 26', Grades to Gray, Fine SAND, Trace Silt and Medium Sand (SP-SM)		
		10	1.0	30		Gray, Silty Clay Layer (1/4") at 27'		
						Trace to Little Medium to Coarse Sand at 30'		
		11	0.2			Trace Fine Gravel at 33'		
				35				
						End of Boring at 35.0 ft Installed Well to 35.0 ft		
				40				

GENERAL NOTES

Start 3/12/90
End 3/20/90
Driller ETI
Rig D-50

Logger TJM
Editor
Chief KKT
Drill Method 4 1/4" I.D. HSA 0-17'; 8 1/4" I.D. HSA 0-17.

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

MONTGOMERY WATSON



LOG OF TEST BORING

Project American Chemical Service, Inc.
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW10
Well No. MW10
Sheet 1 of 1
Surface Elevation 633.0
Northing: 7784.0
Easting: 5200.0

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

SAMPLE					SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID	Depth (ft.)				
						Straight Drill to 5'		
						Black Silty Fine SAND (SM)		
		1	13.0	5		Gray Fine to Coarse SAND, Trace to Some Gravel, 4.0' to 5.5'		
						Grades to Gray Fine SAND, Trace Silt and Medium Sand, Wet (SM-SP)		
		2	20.0	10		Trace to Some Silt at 11-12', Some Gradational Fine to Coarse Sand Layering with Trace Fine to Coarse Sand and Fine Gravel, Trace Organics (roots)		
		3	8.0					
		4	10.0	15		Increased Silt and Fine to Coarse Gravel to 13.8'		
		5	8.0					
		6	15.0			Dense Gray Silty CLAY, Trace Fine Sand and Fine Gravel, Moist		
		7	25.0	20		Trace Coarse Pebbles at 17.5'		
		8	20.0			Gray Silty CLAY to 20.2'		
		9	22.0			Gray Fine to Coarse SAND, Trace to Some Silt (SM)		
		10	13.0	25		Gray Fine SAND, Trace Medium Sand and Silt, Wet (SP)		
		11	13.0			Gray Silty SAND and GRAVEL, Trace Shale Pebbles (GM)		
		12	13.0	30		Gray Fine Sandy CLAY, Very Silty, Trace of Shale Gravel (SC)		
		13	12.0			Grades to Gray Silty Fine SAND, Trace Clay, Trace of Thin Silt-Clay Laminations at 27.3-28' (SM)		
		14	14.0	35		Gray Fine to Medium SAND, Trace Fine to Medium Gravel (SP), Trace to Little Silty Layers at 29-29.5', Trace Coarse Sand		
				40		End of Boring at 35.0 Ft Install Well MW10 to 35.0 ft		

Set 6" Permanent Casing to 15'

GENERAL NOTES

Start 4/26/90
End 5/2/90
Driller ETI
Rig D-50

Logger TJM
Editor
Chief KKT
Drill Method 4 1/4" I.D. HSA

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

WARZYN

LOG OF TEST BORING

Project American Chemical Services
RI/FS Phase II
 Location Griffith, Indiana

Boring No. MW10A
 Surface Elevation 634.3
 Job No. 60251.12
 Sheet 1 of 2

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)			
					2" Black Sandy Silt TOPSOIL					
					Loose Reddish-Brown Silty Fine SAND (SM)					
1	24	M	7	5	Grades into Loose Gray Fine to Medium SAND, Little to Some Silt, Sandy Silt Seam at 7', occasional thin (1/4" to 1/2") silt seams (SM)		6.0			
2	24	W	35	10	Medium Dense Gray Fine to Medium SAND, Little to Some Silt, occasional thin silt layers (SM)		40.0			
3	18	W	23				40.0			
4	24	W	53	15			35.0			
5		W	28				5.0			
6	24	M	129		Very Stiff to Hard Gray Lean CLAY, Trace Gravel (CL) Trace of Clayey Sand and Gravel at 19.0'		4.0			
7	16	W	153	20			2.5			
8	12	W	132		Gray Fine to Medium SAND, Trace Silt and Fine to Coarse Gravel, Trace of Silt Laminations, wet with chemical-like odors (SP-SM)		2.0			
9	15	W/M	92		Grades into Gray Fine SAND		13.0			
10	18	M/W	121	25	Gray Clayey SILT and Silty CLAY (layered), Trace to Some Fine Sand and Gravel (ML)		9.0			
					Increased Amount of Gray Silty CLAY, Trace Fine Sand and Fine to Medium (Shale and Limestone) Gravel		0.4			
				30	Grades to Gray Clayey SILT, Trace to Little Fine Sand (laminated) (CL-ML)		0.0			
							0.0			
							0.0			

WATER LEVEL OBSERVATIONS

hile Drilling 7.0 Upon Completion of Drilling
 Time After Drilling
 Depth to Water
 Depth to Cave in

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 3/21/90 End 3/27/90
 Driller ETI Chief KKT Rig D-50
 Logger PMS Editor TJM
 Drill Method 4.25" HSA

WARZYN



LOG OF TEST BORING

Project American Chemical Services
RI/ES Phase II
 Location Griffith, Indiana

Boring No. MW10A
 Surface Elevation 634.3
 Job No. 60251.12
 Sheet 2 of 2

2100 CORPORATE DRIVE • ADDISON, ILLINOIS 60101 • TEL (708) 691-5000

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES			
No.	Rec P (in.)	Moist	N Value	Depth (ft.)		qu (qa) (tsf)	PI (ppm)		
				35	Gray Fine to Medium SAND, Slight Trace of Clayey Pockets (1/4" layers) at 26.8' (SP)				
				40	End of Boring at 27.0 Feet Abandoned Location for Deep Monitoring Well Tremmie Grout Borehole				
				45					
				50					
				55					
				60					
				65					
				70					

WARZYN

LOG OF TEST BORING

Project American Chemical Services

RI/FS Phase II

Location Griffith, Indiana

Boring No. MW10B

Surface Elevation 634.2

Job No. 60251.12

Sheet 1 of 1

2100 CORPORATE DRIVE - ADDISON, ILLINOIS 60101 - TEL (708) 691-5000

SAMPLE

VISUAL CLASSIFICATION and Remarks

SOIL PROPERTIES

No.	Rec (in.)	Moist	N Value	Depth (ft.)		qu (qs) (tsf)	PID (ppm)			
					Straight Drill to 5' 6" of Dark Organic SILT on Surface					
1		W	18	5	Light Brown Fine to Coarse SAND (SM)					
2		W	42	10	Light Brown and Gray Fine to Coarse SAND, Trace Gravel (SP-SM)					
3		W	40	15						
4		W	62	15			30.0			
5		M	104	20	Light Brown to Gray Silty CLAY, Trace of Fine to Coarse Gravel (CL-ML)		20.0			
6		M/W	115	20	Gray Silty to Sandy CLAY (SC)		30.0			
					End of Boring at 21.0 Feet Abandoned Location for Deep Monitoring Well Tremmie Grout Borehole		10.0			
				25						
				30						

WATER LEVEL OBSERVATIONS

While Drilling 5.5 Upon Completion of Drilling 5

Time After Drilling _____

Depth to Water _____

Depth to Cave in _____

The stratification lines represent the approximate boundary between soil types; the transition may be gradual.

GENERAL NOTES

Start 3/28/90 End 3/28/90

Driller ETI Chief KKT Rig D-50

Logger PMS Editor TJM

Drill Method 4.25" HSA

MONTGOMERY WATSON



LOG OF TEST BORING

Project American Chemical Service, Inc.
RI/FS Phase II
Location Griffith, Indiana

Boring No. MW10C
Well No. MW10C
Sheet 1 of 1
Surface Elevation 634.7
Northing: 7554.0
Easting: 5229.0

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

SAMPLE				SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	Depth (ft.)				
					Straight Drill to 5'		
					Brown Medium to Coarse Silty SAND, Trace of Shale and Coarse Gravel (SP-SM)		
		1	3.0	5			
					Gray Fine Dark SAND, Trace of Silt (SM)		
		2	50.0	10			
					Silty Clay Layer (2") at 10.2'		
					Becomes Dark Gray to Brown Fine to Coarse SAND, Trace Coarse Sand (SP-SM)		
		3	15.0				
					Dark Gray to Brown Fine SAND, Interbedded with Coarse Sand and Gravel Layers (SP-SM)		
		4	2.5	15			
					Brown Silty CLAY Layer (3") at 13.6'		
		5	0.0				
					Light Brown Fine SAND Layer (4") at 14.2'		
		6	2.0	20			
					Dense Gray Lean CLAY, Trace of Shale and Gravel (CL)		Set 6" Permanent Casing to 17'
		7	3.0				
					Gray Silty CLAY, Trace Fine to Coarse Sand and Fine Gravel (CL-ML)		
		8	1.0				
					Gray Fine to Coarse SAND, Trace Fine to Coarse GRAVEL, Silt and Clay (SP-SM)		Odor Present
					Gray Silty CLAY, Trace Fine to Coarse Sand (CL-ML)		
					End of Boring at 25.0 Ft Well Venting Gas		

GENERAL NOTES

Start 3/28/90
End 4/3/90
Driller ETI
Rig D-50

Logger SJB
Editor TJM/SJC
Chief KKT
Drill Method 4.25" I.D. HSA, 5.875" RWB

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

**MONTGOMERY
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LOG OF TEST BORING

Project **American Chemical Service, Inc.**

Location **Griffith, Indiana**

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

Boring No. **MW21**

Well No.

Sheet **1 of 1**

Surface Elevation **631.3**

Northing: **7067.0**

Easting: **4546.0**

SAMPLE					SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID	Depth (ft.)				
1				5		Southeast Edge of Marsh Area Black Organic Sand on Surface Straight Drilled to 4.5'		
2				10		Black to Gray, Fine SAND, Trace Silt (SW) Wet and Runny, No Odor		
3						Increased Silt, Trace Clay		
4				15		Dense, Gray, Silty CLAY, Trace Fine Gravel (CL-ML) Set 6" Permanent Casing to 14.5' Trace Fine to Coarse Gravel at 15-17'		
5						Trace Fine Sandy Silt at 18-19'		
6				20				
7						Very Dense and Slightly Darker Gray at 23'		
8				25		Gray, Fine to Medium SAND, Trace Fine Gravel (SW) Trace Silt at 27-29'		
9								
10				30				
				35		End of Boring at 33.1 ft Installed Well to 33.1 ft		
				40				

GENERAL NOTES

Start **12/13/90**
End **12/18/90**
Driller **Mathes**
Rig **CME 550**

Logger **TJM**
Editor **DSP**
Chief **CSH**
Drill Method **3 7/8" RWB**

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

**MONTGOMERY
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LOG OF TEST BORING

Project American Chemical Service, Inc.

Location Griffith, Indiana

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

Boring No. MW22

Well No.

Sheet 1 of 2

Surface Elevation 634.0

Northing: 4898.0

Easting: 5208.0

SAMPLE					SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID	Depth (ft.)				
						Grassy Surface Underlain by Brown, Fine SAND (SW) Straight Drilled to 12.0'		
				5		Becomes Gray, Fine SAND at 4'		
				10		At 9-10' Grades back to Brown, Fine SAND, Trace Fine to Coarse Gravel (SW)		
1						At 12' Brown and Gray, Fine SAND, Trace to Some Silt and Silty Clay Layering (SM)		
2				15		Increasingly Siltier with Depth		
3						All Gray at 16' with Increased Silt and Clay Layering		
4				20		Gray, Silty Fine SAND, Trace to Some Medium Dense Gray Silt, Trace to Little Clay (SM)		
5						Gray, Silty CLAY Layered with Gray, Silty Fine Sand at 20-24' (0.2 to 0.8' Thick) (CL-ML)		
6				25		Set 6" Permanent Casing to 25.0'		
7						Gray Fine to Medium SAND, Trace Silt and Fine Gravel (SM)		
8						Gray, Clayey SILT, Trace to Some, Fine Sand (ML)		
9				30		Gray, Fine to Medium SAND, Trace Silt (SM)		
10						Gray, Silty, Fine SAND, Trace Clay (SM)		
11				35		Gray, Clayey SILT, Trace Fine Sand (ML)		
						Gray, Silty CLAY, Trace Fine Sand (CL-ML)		
						Gray, Fine SAND, Layered (SW-SM)		
						Gray, Silty CLAY, Trace to Some Fine Sand (CL-ML)		
12				40		Gray, Fine SAND, Trace Medium Sand (SW)		

GENERAL NOTES

Start 12/14/90
End 12/20/90
Driller Mathes
Rig CME 550

Logger TJM
Editor DSP
Chief CSH
Drill Method 3 7/8" RWB

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

**MONTGOMERY
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LOG OF TEST BORING

Project **American Chemical Service, Inc.**

Location **Griffith, Indiana**

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

Boring No. **MW22**

Well No.

Sheet **2 of 2**

Surface Elevation **634.0**

Northing: **4898.0**

Easting: **5208.0**

SAMPLE					SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID	Depth (ft.)				
13						Gray, Fine SAND and SILT, Interbedded (1" t 6") (SM-ML)		
14						Gray, Fine to Coarse SAND and GRAVEL (SP)		
15				45		Dense, Gray, Silty CLAY, Trace Fine to Coarse Gravel (CL-ML), Trace Pebbles at 42'		
16				50		Gray, Fine to Medium SAND, Trace Fine to Medium Gravel and Pebbles (SM) Increased Medium to Coarse Sand at 53-55'		
17				55	End of Boring at 55.0 ft Installed Well to 54.5 ft			
				60				
				65				
				70				
				75				
				80				
				85				

**MONTGOMERY
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LOG OF TEST BORING

Project **American Chemical Service, Inc.**

Location **Griffith, Indiana**

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

Boring No. **MW23**
Well No.
Sheet **1 of 1**
Surface Elevation **631.1**
Northing: **7404.0**
Easting: **4717.0**

SAMPLE					SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID	Depth (ft.)				
				0		Dark Gray, Silty, Fine SAND, Trace Coarse Sand (SM) (Based on Cuttings)		
				5				
				10		Medium Dense, Gray, Fine to Coarse SAND, Trace Silt (SP)		
1								
2						Dense, Gray, Silty CLAY, Trace Fine to Coarse Sand (CL-ML)		
3				15		Seat 6" Permanent Casing to 15'		
4						Trace Fine Sand and Pebbles at 16-18'		
5				20		Gray, Fine to Medium SAND Layer, Trace Silt and Fine Gravel (SP)		
6						Very Dense, Gray, Silty CLAY, Trace Fine Sand (CL-ML)		
7				25		Grades to Dense, Gray SILT, Trace to Some Clay, Trace Fine Sand		
						Gray and Dark Gray, Fine to Medium SAND (SP)		
8				30		Layer (1.5") of Fine to Coarse SAND and GRAVEL at 29.8'		
				35				
				40				
						End of Boring at 31.0 ft Install Well to 30.3 ft		

GENERAL NOTES

Start **1/9/91**
End **1/15/91**
Driller **ETI**
Rig **D50**

Logger **DP/TM**
Editor **DSP**
Chief **MES**
Drill Method **4 7/8" RWB**

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

MONTGOMERY WATSON



LOG OF TEST BORING

Project American Chemical Service, Inc.

Location Griffith, Indiana

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

Boring No. MW24

Well No.

Sheet 1 of 1

Surface Elevation 633.1

Northing: 8033.0

Easting: 4596.0

SAMPLE				SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID				
					Dark Gray, Fine, Sandy SILT, Trace Coarse Sand (SM-ML) (Based on Cuttings)		
1					Medium Dense, Gray, Fine SAND, Trace Silt and Coarse Sand (SM-SP)		
2					Gray SILT and Fine to Medium SAND (Interbedded Layer) (ML-SM)		
3					Medium Dense, Gray SILT, Little to Some Clay, Trace Fine Sand (ML)		
4					Dense, Gray, Silty CLAY, Trace Fine to Coarse Sand (CL-ML)		
5					Seat 6" Permanent Casing to 16'		
6					Gray Fine SAND, Trace Medium Sand and Silt (SM)		
7					Gray Silty CLAY Layer (2.5") at 23.3'		
8					Trace to Little Silt at 27.5'		
					End of Boring at 31 ft Install Well to 31 ft		

GENERAL NOTES

Start 1/8/91
End 1/11/91
Driller ETI
Rig D50

Logger DSP
Editor TM/DS
Chief MES
Drill Method 4 7/8" RWB

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

**MONTGOMERY
WATSON**



LOG OF TEST BORING

Project **American Chemical Service, Inc.**

Location **Griffith, Indiana**

Boring No. **M-1D**

Well No.

Sheet **1 of 2**

Surface Elevation **637.1**

Northing: **5747.0**

Easting: **4359.0**

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

SAMPLE					SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID	Depth (ft.)				
						SAND		
				5		CLAY		
						SAND		
				10				
				15				
				20		CLAY		
				25				
				30				
				35				
				40		SW/GP CLAY		

GENERAL NOTES

Start
End
Driller
Rig

Logger
Editor
Chief
Drill Method

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

**MONTGOMERY
WATSON**



LOG OF TEST BORING

Project **American Chemical Service, Inc.**

Location **Griffith, Indiana**

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

Boring No. **M-1D**

Well No.


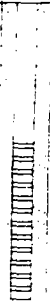
Sheet **2 of 2**

Surface Elevation **637.1**

Northing: **5747.0**

Easting: **4359.0**

SAMPLE

Run No.	TYPE	Sample No.	PID	Depth (ft.)	SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
				45		SAND		
				50				
				55				
				60				
				65				
				70				
				75				
				80				
				85				

End of Boring at 50.5 ft

**MONTGOMERY
WATSON**



LOG OF TEST BORING

Project **American Chemical Service, Inc.**

Location **Griffith, Indiana**

Boring No. **M-2D**

Well No.

Sheet **1 of 2**

Surface Elevation **635.0**

Northing: **6495.0**

Easting: **3997.0**

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

SAMPLE					SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID	Depth (ft.)				
				5		SAND (SP)		
						PEAT (PT)		
				10		SAND (SP)		
				15				
				20		CLAY (CL)		
				25				
				30				
				35				
				40				

GENERAL NOTES

Start
End
Driller
Rig

Logger
Editor
Chief
Drill Method

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

**MONTGOMERY
WATSON**



LOG OF TEST BORING

Project **American Chemical Service, Inc.**

Location **Griffith, Indiana**

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

Boring No. **M-2D**

Well No.

Sheet **2 of 2**

Surface Elevation **635.0**

Northing: **6495.0**

Easting: **3997.0**

SAMPLE				SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID				
			Depth (ft.)				
			45				
			50		SAND (SP)		
			55				
					End of Boring at 55.0 ft		
			60				
			65				
			70				
			75				
			80				
			85				

**MONTGOMERY
WATSON**



LOG OF TEST BORING

Project **American Chemical Service, Inc.**

Location **Griffith, Indiana**

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

Boring No. **M-3D**

Well No.

Sheet **1 of 1**

Surface Elevation **630.5**

Northing: **6821.0**

Easting: **4144.0**

SAMPLE					SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID	Depth (ft.)				
				5		SAND (SP)		
				10				
				15		CLAY (CL)		
				20				
				25		SAND (SP)		
				30				
				35		End of Boring at 31.0 ft		
				40				

GENERAL NOTES

Start
End
Driller
Rig

Logger
Editor
Chief
Drill Method

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

MONTGOMERY WATSON



LOG OF TEST BORING

Project American Chemical Service, Inc.

Location Griffith, Indiana

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

Boring No. **M-4D**
Well No.
Sheet **1 of 2**
Surface Elevation **631.4**
Northing: **6538.0**
Easting: **4949.0**

SAMPLE					SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID	Depth (ft.)				
				5		SAND (SP)		
				10				
				15		CLAY (CL)		
				20				
				25				
				30				
				35				
				40		SAND (SP)		
						CLAY (CL)		

GENERAL NOTES

Start
End
Driller
Rig

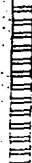
Logger
Editor
Chief
Drill Method

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

Project American Chemical Service, Inc.

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

Boring No. **M-4D**
Well No.
Sheet **2 of 2**
Surface Elevation **631.4**
Northing: **6538.0**
Easting: **4949.0**

SAMPLE				SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID				
				45	SAND (SP)		
				50			
					End of Boring at 51.0 ft		
				55			
				60			
				65			
				70			
				75			
				80			
				85			

**MONTGOMERY
WATSON**



LOG OF TEST BORING

Project **American Chemical Service, Inc.**

Location **Griffith, Indiana**

2100 Corporate Drive, Addison, Illinois 60101, TEL. (708) 691-5000

Boring No. **M-5D**
Well No.
Sheet **1 of 1**
Surface Elevation **633.0**
Northing: **7094.0**
Easting: **4171.0**

SAMPLE					SOIL GRAPHIC	VISUAL CLASSIFICATION	WELL DIAGRAM	REMARKS
Run No.	TYPE	Sample No.	PID	Depth (ft.)				
						SAND (SP)		
				5				
						SILT (ML)		
						SAND (SP)		
				10				
						CLAY (CL)		
				15				
				20		SAND (SP)		
				25				
				30				
						End of Boring at 31.0 ft		
				35				
				40				

GENERAL NOTES

Start
End
Driller
Rig

Logger
Editor
Chief
Drill Method

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

MONTGOMERY WATSON



LOG OF TEST BORING

Project **American Chemical Service, Inc.**

Location **Griffith, Indiana**

Boring No. **CB01**

Job No. **4077.0075**

Sheet **1** of **1**

Surface Elevation **634.5**

Northing:

Easting:

41551 Eleven Mile Road, P.O. Box 8012, Novi, MI 48376, TEL. (810) 344-0205

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES		
No.	Rec. (in.)	Mois- ture	N Value	Depth (ft.)		qu (qa) (tsf)	PID (ppm)	Remarks
					Black, Sandy Loam (TOPSOIL)		0.0	
					Brown, Fine SAND (SP)			
1	1.5	W	19	5	Gray, Fine to Coarse SAND, Silt and Fine Gravel (SP) Gray, Fine SAND, Trace Silt, Slight Odor Present (SP)		18.0	
2	1.5	W	53	10	Increased Medium Sand to Trace to Little Medium Sand		14.0	
3	1.3	W	32				14.0	
4	1.8	M	90	15	1/4" Thin Silt Seam at 13.9' Dense, Gray, Silty CLAY, Trace Fine to Medium Gravel (Trace Shale) (CL-ML)		1.0	
5	1.0	M	93		Gray/Light Gray, Fine SAND, Trace Silt (SP)		2.0	
					End of Boring at 18.0 ft			

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling ∇ 4.0 ft. Upon Completion of Drilling ∇ ft.
 Time After Drilling _____
 Depth to Water _____
 Depth to Cave in _____

Start 9/11/90 End 9/11/90
 Driller ETI Chief MES Rig D50
 Logger TJM Editor
 Drill Method 3 7/8" RWB

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

G



G1

BAROMETRIC PRESSURE DATA

Meteorological Data
Gary Indiana Airport

Page 2

			Wind	Wind
	Barometer	Air Temp	Speed	Direction
Date / Time	(inches Hg)	F	mph	(degrees)
2/4/96 11:00	30.63	-2	12	260
2/4/96 12:00	30.62	0	12	260
2/4/96 13:00	30.6	3	12	250
2/4/96 14:00	30.58	5	10	270
2/4/96 16:00	30.56	6	14	260
2/4/96 17:00	30.56	6	12	260
2/4/96 18:00	30.55	5	10	250
2/4/96 19:00	30.55	5	10	250
2/4/96 20:00	30.54	5	9	240
2/4/96 21:00	30.51	4	9	200
2/5/96 5:00	30.3	6	14	200
2/5/96 6:00	30.28	7	14	200
2/5/96 7:00	30.28	9	14	200
2/5/96 8:00	30.28	13	17	220
2/5/96 9:00	30.27	15	14	250
2/5/96 11:00	30.29	22	14	270
2/5/96 12:00	30.28	24	14	280
2/5/96 13:00	30.28	25	13	280
2/5/96 14:00	30.29	24	12	300
2/5/96 15:00	30.29	24	9	300
2/5/96 16:00	30.32	24	9	310
2/5/96 17:00	30.34	24	8	300
2/5/96 18:00	30.37	21	8	350
2/5/96 19:00	30.39	20	8	350
2/5/96 20:00	30.41	20	7	350
2/5/96 21:00	30.41	19	7	310
2/6/96 5:00	30.42	11	0	0
2/6/96 6:00	30.42	11	6	200
2/6/96 7:00	30.42	10	6	180
2/6/96 9:00	30.4	16	10	180
2/6/96 10:00	30.42	22	9	180
2/6/96 12:00	30.35	30	16	180
2/6/96 13:00	30.31	32	14	170
2/6/96 20:00	30.09	33	14	160
2/6/96 21:00	30.07	33	14	160
2/7/96 5:00	29.81	35	17	180
2/7/96 6:00	29.81	37	17	200
2/7/96 7:00	29.79	40	17	200
2/7/96 8:00	29.8	40	17	210
2/7/96 9:00	29.81	41	17	220
2/7/96 10:00	29.79	44	14	220
2/7/96 11:00	29.8	44	14	210
2/7/96 12:00	29.8	45	14	240
2/7/96 13:00	29.77	47	16	220
2/7/96 14:00	29.76	46	14	210
2/7/96 15:00	29.74	46	14	210
2/7/96 17:00	29.72	45	12	180
2/7/96 18:00	29.76	44	15	210
2/7/96 20:00	29.75	44	14	200
2/7/96 21:00	29.76	43	14	200
2/7/96 22:00	29.75	43	17	200

			Wind	Wind
	Barometer	Air Temp	Speed	Direction
Date / Time	(Inches Hg)	F	mph	(degrees)
2/7/96 23:00	29.75	42	16	190
2/8/96 0:00	29.72	42	15	180
2/8/96 6:00	29.58	44	12	220
2/8/96 7:00	29.59	44	14	230
2/8/96 8:00	29.53	45	14	220
2/8/96 9:00	29.55	45	14	240
2/8/96 10:00	29.54	46	14	240
2/8/96 11:00	29.56	49	14	260
2/8/96 13:00	29.61	44	14	280
2/8/96 14:00	29.61	45	12	280
2/8/96 15:00	29.62	45	12	280
2/8/96 16:00	29.64	46	12	280
2/8/96 17:00	29.68	44	12	280
2/8/96 18:00	29.71	43	12	280
2/8/96 19:00	29.74	42	12	270
2/8/96 20:00	29.77	40	12	270
2/8/96 21:00	29.78	40	12	270
2/9/96 5:00	29.87	34	12	260
2/9/96 6:00	29.87	33	12	260
2/9/96 7:00	29.89	32	12	260
2/9/96 8:00	29.91	34	9	260
2/9/96 9:00	29.92	37	7	280
2/9/96 10:00	29.93	40	6	290
2/9/96 11:00	29.93	43	6	310
2/9/96 13:00	29.89	48	9	200
2/9/96 14:00	29.87	49	13	200
2/9/96 15:00	29.87	50	12	220
2/9/96 16:00	29.86	50	12	210
2/9/96 17:00	29.86	47	9	200
2/9/96 18:00	29.85	46	9	200
2/9/96 19:00	29.85	44	9	200
2/9/96 20:00	29.83	43	9	190
2/9/96 21:00	29.82	43	10	190
2/10/96 5:00	29.6	43	14	210
2/10/96 6:00	29.59	43	14	210
2/10/96 7:00	29.58	43	14	210
2/10/96 8:00	29.57	44	17	200
2/10/96 9:00	29.54	47	14	210
2/10/96 10:00	29.51	49	14	210
2/10/96 11:00	29.5	53	14	210
2/10/96 12:00	29.47	55	17	240
2/10/96 13:00	29.47	57	17	260
2/10/96 14:00	29.47	56	14	260
2/10/96 15:00	29.5	56	14	270
2/10/96 16:00	29.53	54	14	270
2/10/96 17:00	29.56	47	14	270
2/10/96 18:00	29.61	42	17	270
2/10/96 19:00	29.63	40	17	270
2/10/96 20:00	29.64	38	17	270
2/10/96 21:00	29.63	37	17	270
2/11/96 5:00	29.65	35	14	270

			Wind	Wind
	Barometer	Air Temp	Speed	Direction
Date / Time	(inches Hg)	F	mph	(degrees)
2/11/96 6:00	29.66	35	14	270
2/11/96 7:00	29.68	35	14	270
2/11/96 8:00	29.72	34	14	280
2/11/96 9:00	29.74	33	14	290
2/11/96 10:00	29.76	33	14	290
2/11/96 11:00	29.79	33	17	310
2/11/96 12:00	29.83	32	17	310
2/11/96 13:00	29.85	32	17	320
2/11/96 14:00	29.88	32	12	340
2/11/96 15:00	29.92	31	12	340
2/11/96 16:00	29.94	30	12	340
2/11/96 17:00	29.97	31	12	340
2/11/96 18:00	30	31	12	340
2/11/96 20:00	30.03	30	15	330
2/11/96 21:00	30.05	30	12	330
2/12/96 5:00	30.15	22	12	320
2/12/96 6:00	30.16	21	12	310
2/12/96 7:00	30.16	21	12	310
2/12/96 9:00	30.21	20	12	310
2/12/96 10:00	30.23	20	12	310
2/12/96 11:00	30.24	21	12	310
2/12/96 12:00	30.23	22	15	340
2/12/96 13:00	30.23	23	17	350
2/12/96 14:00	30.21	24	12	350
2/12/96 15:00	30.21	24	12	350
2/12/96 16:00	30.21	25	12	350
2/12/96 17:00	30.2	26	12	310
2/12/96 18:00	30.21	25	12	290
2/12/96 19:00	30.22	24	12	290
2/12/96 20:00	30.22	24	12	300
2/12/96 21:00	30.21	24	9	290
2/13/96 5:00	30.07	24	7	180
2/13/96 6:00	30.05	25	8	180
2/13/96 7:00	30.02	25	8	180
2/13/96 8:00	29.98	26	12	180
2/13/96 9:00	29.94	28	12	180
2/13/96 11:00	29.82	33	12	180
2/13/96 12:00	29.75	34	17	160
2/13/96 14:00	29.61	36	16	180
2/13/96 15:00	29.57	36	16	180
2/13/96 16:00	29.55	38	15	180
2/13/96 17:00	29.52	38	12	190
2/13/96 18:00	29.48	36	15	200
2/13/96 19:00	29.47	38	12	240
2/13/96 20:00	29.48	37	12	270
2/13/96 21:00	29.51	34	12	290
2/14/96 5:00	29.55	30	12	280
2/14/96 6:00	29.56	30	8	280
2/14/96 7:00	29.56	30	8	270
2/14/96 8:00	29.58	30	9	270
2/14/96 9:00	29.6	32	12	280

			Wind	Wind
	Barometer	Air Temp	Speed	Direction
Date / Time	(inches Hg)	F	mph	(degrees)
2/14/96 10:00	29.6	34	9	280
2/14/96 11:00	29.61	32	15	350
2/14/96 12:00	29.6	31	6	340
2/14/96 13:00	29.61	32	12	10
2/14/96 14:00	29.61	30	9	360
2/14/96 16:00	29.64	30	9	360
2/14/96 17:00	29.66	30	6	360
2/14/96 18:00	29.69	29	12	360
2/14/96 19:00	29.72	29	12	360
2/14/96 20:00	29.72	28	12	330
2/14/96 21:00	29.75	28	15	330
2/15/96 5:00	29.8	23	6	280
2/15/96 6:00	29.82	23	8	280
2/15/96 7:00	29.82	22	8	280
2/15/96 8:00	29.84	23	8	280
2/15/96 9:00	29.84	27	6	290
2/15/96 11:00	29.84	29	12	290
2/15/96 12:00	29.83	30	12	270
2/15/96 13:00	29.82	32	7	280
2/15/96 14:00	29.82	30	12	290
2/15/96 15:00	29.84	28	7	330
2/15/96 16:00	29.85	27	7	20
2/15/96 17:00	29.87	26	7	20
2/15/96 18:00	29.89	26	8	20
2/15/96 19:00	29.92	26	12	20
2/15/96 20:00	29.94	25	16	20
2/15/96 21:00	29.97	25	16	20
2/16/96 5:00	30.1	23	14	10
2/16/96 6:00	30.12	23	14	20
2/16/96 7:00	30.15	21	12	300
2/16/96 8:00	30.16	21	14	310
2/16/96 9:00	30.17	20	12	340
2/16/96 10:00	30.19	21	12	320
2/16/96 11:00	30.19	22	12	230
2/16/96 12:00	30.16	24	10	340
2/16/96 13:00	30.14	25	12	310
2/16/96 14:00	30.1	26	10	290
2/16/96 15:00	30.09	26	12	270
2/16/96 16:00	30.09	26	12	270
2/16/96 17:00	30.08	25	16	260
2/16/96 18:00	30.06	23	17	260
2/16/96 19:00	30.05	23	12	260
2/16/96 20:00	30.03	24	14	250
2/16/96 21:00	30.01	24	14	250
2/17/96 5:00	29.71	25	12	200
2/17/96 6:00	29.68	25	12	200
2/17/96 7:00	29.67	25	12	210
2/17/96 8:00	29.66	25	12	210
2/17/96 9:00	29.64	25	12	210
2/17/96 10:00	29.63	27	12	240
2/17/96 11:00	29.65	30	12	270

	Barometer	Air Temp	Wind	Wind
Date / Time	(inches Hg)	F	Speed mph	Direction (degrees)
2/17/96 13:00	29.68	25	12	230
2/17/96 15:00	29.75	25	15	330
2/17/96 16:00	29.79	24	15	330
2/17/96 17:00	29.83	24	12	330
2/17/96 18:00	29.87	24	12	330
2/17/96 19:00	29.92	23	15	330
2/17/96 20:00	29.94	24	12	330
2/17/96 21:00	29.94	24	12	330
2/18/96 5:00	29.97	16	7	280
2/18/96 6:00	29.96	15	7	280
2/18/96 7:00	29.96	14	7	280
2/18/96 8:00	29.97	15	6	320
2/18/96 9:00	29.98	21	7	290
2/18/96 10:00	29.98	23	9	190
2/18/96 11:00	29.96	25	9	210
2/18/96 12:00	29.93	27	7	230
2/18/96 13:00	29.9	32	7	200
2/18/96 15:00	29.86	30	12	220
2/18/96 16:00	29.85	30	12	220
2/18/96 20:00	29.83	29	12	190
2/18/96 21:00	29.83	28	12	160
2/19/96 5:00	29.72	31	10	150
2/19/96 6:00	29.72	29	9	150
2/19/96 7:00	29.71	30	14	150
2/19/96 8:00	29.73	31	14	150
2/19/96 9:00	29.73	34	12	160
2/19/96 10:00	29.73	37	12	160
2/19/96 11:00	29.73	41	12	180
2/19/96 12:00	29.72	44	12	180
2/19/96 13:00	29.7	47	9	200
2/19/96 14:00	29.68	49	12	180
2/19/96 15:00	29.67	51	14	170
2/19/96 16:00	29.66	52	14	160
2/19/96 17:00	29.67	50	12	160
2/19/96 18:00	29.68	47	7	240
2/19/96 19:00	29.69	44	7	220
2/19/96 20:00	29.7	42	12	160
2/19/96 21:00	29.7	40	12	160
2/20/96 5:00	29.72	38	9	170
2/20/96 6:00	29.73	38	12	170
2/20/96 7:00	29.73	38	12	170
2/20/96 8:00	29.73	39	16	170
2/20/96 10:00	29.72	43	14	160
2/20/96 11:00	29.73	48	16	160
2/20/96 12:00	29.72	49	13	160
2/20/96 13:00	29.69	51	14	150
2/20/96 14:00	29.69	53	14	150
2/20/96 15:00	29.67	53	12	150
2/20/96 16:00	29.69	54	12	150
2/20/96 18:00	29.74	52	8	150
2/20/96 19:00	29.77	50	7	100

Meteorological Data
Gary Indiana Airport

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			Wind	Wind
	Barometer	Air Temp	Speed	Direction
Date / Time	(inches Hg)	F	mph	(degrees)
2/20/96 20:00	29.77	50	7	100
2/20/96 21:00	29.8	49	0	0
2/21/96 5:00	29.99	31	17	350
2/21/96 6:00	30.04	32	14	340
2/21/96 7:00	30.06	32	14	340
2/21/96 8:00	30.07	32	14	340
2/21/96 9:00	30.09	33	14	330
2/21/96 11:00	30.1	33	12	330
2/21/96 14:00	30.08	34	12	350
2/21/96 15:00	30.09	34	12	350
2/21/96 16:00	30.09	33	12	350
2/21/96 17:00	30.1	33	14	350
2/21/96 18:00	30.1	33	12	350
2/21/96 19:00	30.1	33	12	350
2/21/96 20:00	30.08	33	14	350
2/21/96 21:00	30.08	33	14	350
2/22/96 5:00	30.03	32	7	10
2/22/96 6:00	30.05	33	9	10
2/22/96 7:00	30.05	33	9	10
2/22/96 8:00	30.04	33	7	10
2/22/96 9:00	30.03	33	12	20
2/22/96 10:00	30.04	34	12	20
2/22/96 11:00	30.05	33	8	20
2/22/96 12:00	30.01	34	10	30
2/22/96 13:00	30.01	35	12	20
2/22/96 14:00	29.98	35	10	30
2/22/96 16:00	29.95	35	12	20
2/22/96 17:00	29.94	35	12	20
2/22/96 19:00	29.93	38	12	120
2/22/96 20:00	29.91	38	14	110
2/22/96 21:00	29.88	38	12	120
2/23/96 5:00	29.69	41	14	130
2/23/96 6:00	29.6	42	14	130
2/23/96 7:00	29.57	42	17	130
2/23/96 8:00	29.54	43	17	130
2/23/96 9:00	29.5	44	12	140
2/23/96 10:00	29.47	45	12	140
2/23/96 11:00	29.43	48	12	140
2/23/96 12:00	29.4	52	12	150
2/23/96 13:00	29.35	52	14	140
2/23/96 14:00	29.32	55	14	160
2/23/96 15:00	29.33	57	12	170
2/23/96 16:00	29.33	60	16	230
2/23/96 17:00	29.4	53	14	260
2/23/96 18:00	29.45	48	14	260
2/23/96 19:00	29.52	45	14	260
2/23/96 20:00	29.58	44	14	260
2/23/96 21:00	29.62	42	14	260
2/24/96 5:00	29.87	35	14	270
2/24/96 6:00	29.89	35	14	270
2/24/96 7:00	29.91	35	12	270

Meteorological Data
Gary Indiana Airport

Page 8

Date / Time	Barometer (inches Hg)	Air Temp F	Wind	Wind
			Speed mph	Direction (degrees)
2/24/96 8:00	29.94	38	12	270
2/24/96 9:00	29.96	41	12	270
2/24/96 10:00	29.96	44	12	260
2/24/96 12:00	29.98	58	12	260
2/24/96 13:00	29.97	55	12	260
2/24/96 14:00	29.96	57	12	260
2/24/96 15:00	29.95	59	12	260
2/24/96 16:00	29.95	60	12	250
2/24/96 17:00	29.96	60	12	250
2/24/96 18:00	29.96	56	12	230
2/24/96 19:00	29.96	52	9	200
2/24/96 20:00	29.96	49	12	200
2/24/96 21:00	29.98	49	12	200
2/25/96 5:00	30.01	42	8	170
2/25/96 6:00	30.01	42	8	170
2/25/96 7:00	30.01	43	9	180
2/25/96 10:00	29.99	53	14	200
2/25/96 11:00	29.98	57	16	200
2/25/96 12:00	29.99	58		
2/25/96 13:00	29.94	58	16	200
2/25/96 14:00	29.91	60	12	180
2/25/96 15:00	29.9	60	12	180
2/25/96 16:00	29.89	60	9	210
2/25/96 17:00	29.88	59	9	190
2/25/96 18:00	29.86	58	9	150
2/25/96 19:00	29.86	57	7	110
2/25/96 20:00	29.85	55	7	90
2/26/96 5:00	29.82	48	9	90
2/26/96 6:00	29.81	48	9	90
2/26/96 7:00	29.81	48	8	110
2/26/96 8:00	29.82	49	8	110
2/26/96 9:00	29.84	52	6	310
2/26/96 10:00	29.85	49	5	340
2/26/96 11:00	29.85	43	6	10
2/26/96 12:00	29.84	47	12	330
2/26/96 13:00	29.83	48	6	340
2/26/96 14:00	29.83	45	5	350
2/26/96 15:00	29.8	46	0	0
2/26/96 17:00	29.78	41	7	340
2/26/96 18:00	29.77	40	5	350
2/26/96 20:00	29.76	39	0	0
2/27/96 5:00	29.65	58	9	350
2/27/96 6:00	29.64	57	9	10
2/27/96 7:00	29.69	56	5	320
2/27/96 8:00	29.66	51	6	350
2/27/96 9:00	29.66	52	6	340
2/27/96 10:00	29.67	57	6	180
2/27/96 11:00	29.68	60	16	220
2/27/96 12:00	29.68	59	14	230
2/27/96 13:00	29.68	50	13	260
2/27/96 14:00	29.71	45	14	260

Meteorological Data
Gary Indiana Airport

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			Wind	Wind
	Barometer	Air Temp	Speed	Direction
Date / Time	(inches Hg)	F	mph	(degrees)
2/27/96 15:00	29.7	45	12	270
2/27/96 16:00	29.74	44	12	270
2/27/96 17:00	29.75	42	12	270
2/27/96 18:00	29.77	40	12	270
2/27/96 19:00	29.8	38	12	270
2/27/96 20:00	29.8	36	12	270
2/27/96 21:00	29.82	33	12	270
2/28/96 5:00	29.95	19	14	270
2/28/96 6:00	29.99	17	14	270
2/28/96 7:00	30.02	16	14	270
2/28/96 8:00	30.03	16	14	270
2/28/96 9:00	30.05	16	17	270
2/28/96 10:00	30.07	17	12	270
2/28/96 11:00	30.1	20	12	270
2/28/96 12:00	30.12	19	12	270
2/28/96 13:00	30.11	18	16	260
2/28/96 14:00	30.13	18	12	280
2/28/96 15:00	30.15	18	12	280
2/28/96 16:00	30.18	19	12	280
2/28/96 18:00	30.21	18	12	300
2/28/96 19:00	30.22	16	12	300
2/28/96 20:00	30.23	16	12	300
2/28/96 21:00	30.23	16	12	300
2/29/96 5:00	30.28	14	7	270
2/29/96 6:00	30.28	14	7	270
2/29/96 7:00	30.29	14	7	270
2/29/96 8:00	30.3	14	9	260
2/29/96 9:00	30.3	16	9	260
2/29/96 10:00	30.29	18	9	270
2/29/96 11:00	30.28	19	12	270
2/29/96 12:00	30.26	22	10	270
2/29/96 13:00	30.23	23	13	270
2/29/96 14:00	30.2	23	12	280
2/29/96 15:00	30.17	25	12	250
2/29/96 16:00	30.14	25	14	260
2/29/96 17:00	30.11	24	14	260
2/29/96 18:00	30.09	23	14	260
2/29/96 19:00	30.09	23	14	250
2/29/96 20:00	30.08	22	14	250
2/29/96 21:00	30.07	22	12	240
3/1/96 5:00	29.93	15	10	190
3/1/96 6:00	29.92	15	10	200
3/1/96 7:00	29.9	16	12	200
3/1/96 8:00	29.88	18	14	200
3/1/96 9:00	29.87	25	16	210
3/1/96 10:00	29.84	28	14	210
3/1/96 11:00	29.81	30	14	200
3/1/96 12:00	29.76	34	18	180
3/1/96 13:00	29.72	36	16	210
3/1/96 14:00	29.69	38	23	200
3/1/96 16:00	29.65	38	15	200

			Wind	Wind
	Barometer	Air Temp	Speed	Direction
Date / Time	(inches Hg)	F	mph	(degrees)
3/1/96 17:00	29.65	37	14	200
3/1/96 18:00	29.64	37	12	200
3/1/96 19:00	29.64	38	12	200
3/1/96 20:00	29.65	35	12	260
3/1/96 21:00	29.65	34	12	260
3/2/96 5:00	29.61	28	9	260
3/2/96 6:00	29.62	27	12	270
3/2/96 7:00	29.63	27	12	270
3/2/96 8:00	29.64	27	14	270
3/2/96 9:00	29.64	29	14	270
3/2/96 11:00	29.63	30	17	260
3/2/96 12:00	29.63	27	17	260
3/2/96 13:00	29.63	29	17	260
3/2/96 14:00	29.65	25	17	260
3/2/96 15:00	29.68	25	15	260
3/2/96 16:00	29.7	25	15	260
3/2/96 17:00	29.73	25	15	260
3/2/96 18:00	29.77	20	15	260
3/2/96 19:00	29.82	18	12	260
3/2/96 20:00	29.85	14	12	260
3/2/96 21:00	29.9	11	12	260
3/3/96 5:00	30.17	5	12	270
3/3/96 6:00	30.19	5	14	270
3/3/96 7:00	30.23	6	14	270
3/3/96 8:00	30.26	8	16	270
3/3/96 9:00	30.28	11	16	270
3/3/96 10:00	30.3	14	14	260
3/3/96 11:00	30.33	17	14	250
3/3/96 12:00	30.33	21	14	250
3/3/96 13:00	30.3	23	12	240
3/3/96 14:00	30.3	24	14	250
3/3/96 15:00	30.29	25	12	250
3/3/96 16:00	30.28	25	12	250
3/3/96 17:00	30.3	26	12	250
3/3/96 18:00	30.3	25	15	250
3/3/96 19:00	30.32	24	14	250
3/3/96 20:00	30.32	24	12	250
3/3/96 21:00	30.34	23	9	240
3/4/96 5:00	30.4	16	7	160
3/4/96 6:00	30.38	16	6	200
3/4/96 7:00	30.36	20	0	0
3/4/96 8:00	30.36	24	0	0
3/4/96 9:00	30.37	28	12	180
3/4/96 10:00	30.36	31	16	150
3/4/96 11:00	30.32	33	16	150
3/4/96 12:00	30.29	34	16	150
3/4/96 13:00	30.23	36	16	160
3/4/96 14:00	30.16	36	17	130
3/4/96 15:00	30.1	38	17	140
3/4/96 16:00	30.05	37	17	140
3/4/96 17:00	30.01	35	17	140

Meteorological Data
Gary Indiana Airport

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			Wind	Wind
	Barometer	Air Temp	Speed	Direction
Date / Time	(Inches Hg)	F	mph	(degrees)
3/4/96 18:00	29.99	36	17	140
3/4/96 19:00	29.98	37	14	140
3/4/96 20:00	29.94	37	12	130
3/4/96 21:00	29.91	37	8	100
3/5/96 5:00	29.77	33	8	20
3/5/96 6:00	29.76	34	7	10
3/5/96 7:00	29.78	35	12	350
3/5/96 8:00	29.78	34	16	360
3/5/96 9:00	29.8	34	14	10
3/5/96 10:00	29.82	32	14	10
3/5/96 11:00	29.82	32	14	10
3/5/96 12:00	29.82	33	14	10
3/5/96 13:00	29.81	33	17	20
3/5/96 14:00	29.79	33	14	10
3/5/96 15:00	29.81	31	14	10
3/5/96 16:00	29.83	30	14	10
3/5/96 17:00	29.83	31	14	10
3/5/96 18:00	29.87	32	14	10
3/5/96 19:00	29.88	32	12	10
3/5/96 20:00	29.86	32	12	20
3/5/96 21:00	29.87	32	12	20
3/6/96 5:00	29.92	26	14	20
3/6/96 6:00	29.94	26	14	20
3/6/96 7:00	29.94	25	16	20
3/6/96 8:00	29.95	25	17	20
3/6/96 9:00	29.96	25	17	20
3/6/96 10:00	29.96	25	17	20
3/6/96 11:00	30	24	17	20
3/6/96 12:00	29.99	23	18	360
3/6/96 13:00	30	24	16	10
3/6/96 14:00	30.01	23	14	10
3/6/96 15:00	30.04	24	15	10
3/6/96 16:00	30.04	24	14	10
3/6/96 18:00	30.1	24	14	10
3/6/96 19:00	30.04	24	12	10
3/6/96 20:00	30.12	24	12	10
3/6/96 21:00	30.12	24	12	10
3/7/96 5:00	30.2	16	12	30
3/7/96 6:00	30.22	16	12	30
3/7/96 7:00	30.23	17	12	360
3/7/96 8:00	30.23	17	12	20
3/7/96 9:00	30.23	17	12	20
3/7/96 10:00	30.24	16	12	350
3/7/96 11:00	30.24	15	12	310
3/7/96 12:00	30.26	17	14	300
3/7/96 13:00	30.24	17	17	330
3/7/96 14:00	30.23	18	14	340
3/7/96 15:00	30.2	18	12	340
3/7/96 16:00	30.2	17	12	340
3/7/96 17:00	30.22	16	12	340
3/7/96 18:00	30.24	16	14	340

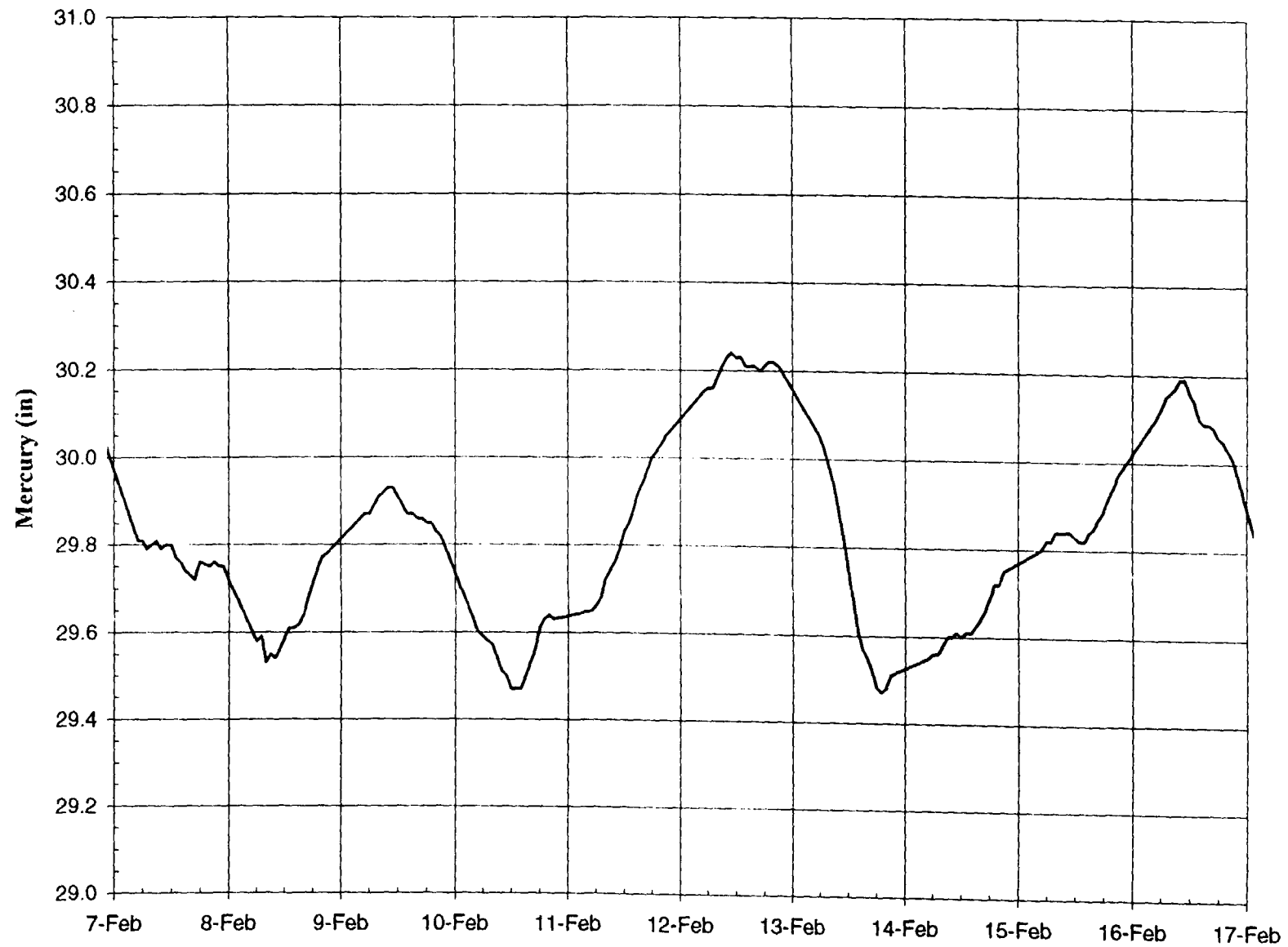
Date / Time	Barometer (inches Hg)	Air Temp F	Wind Speed mph	Wind Direction (degrees)
3/7/96 19:00	30.26	15	12	340
3/7/96 20:00	30.28	12	12	340
3/7/96 21:00	30.28	13	12	340
3/8/96 5:00	30.31	6	12	280
3/8/96 6:00	30.33	7	14	310
3/8/96 7:00	30.34	7	17	300
3/8/96 8:00	30.37	7	16	290
3/8/96 9:00	30.37	9	14	290
3/8/96 10:00	30.37	9	14	290
3/8/96 11:00	30.36	10	12	280
3/8/96 12:00	30.35	12	13	270
3/8/96 13:00	30.33	15	13	270
3/8/96 14:00	30.31	16	14	270
3/8/96 15:00	30.3	17	12	270
3/8/96 16:00	30.3	16	12	260
3/8/96 17:00	30.3	14	12	270
3/8/96 18:00	30.31	14	12	270
3/8/96 21:00	30.36	15	14	270
3/9/96 5:00	30.42	13	9	270
3/9/96 6:00	30.45	13	9	270
3/9/96 7:00	30.46	13	8	270
3/9/96 8:00	30.5	19	8	270
3/9/96 9:00	30.52	23	8	280
3/9/96 10:00	30.54	22	8	300
3/9/96 11:00	30.55	24	8	300
3/9/96 12:00	30.55	28	7	290
3/9/96 13:00	30.53	27	7	290
3/9/96 14:00	30.52	31	7	250
3/9/96 15:00	30.53	32	7	250
3/9/96 16:00	30.54	31	7	240
3/9/96 17:00	30.54	30	8	220
3/9/96 18:00	30.55	27	8	210
3/9/96 19:00	30.57	24	8	200
3/9/96 20:00	30.58	22	8	220
3/9/96 21:00	30.59	22	6	200
3/10/96 5:00	30.65	19	8	150
3/10/96 6:00	30.67	19	6	170
3/10/96 7:00	30.67	20	8	160
3/10/96 8:00	30.68	24	12	150
3/10/96 10:00	30.71	33	12	200
3/10/96 11:00	30.7	34	16	210
3/10/96 12:00	30.68	35	12	180
3/10/96 13:00	30.66	36	12	200
3/10/96 14:00	30.64	36	12	200
3/10/96 15:00	30.64	36	12	200
3/10/96 16:00	30.63	36	12	200
3/10/96 17:00	30.62	37	12	200
3/10/96 18:00	30.62	35	12	190
3/10/96 21:00	30.61	33	7	160

Meteorological Data
Gary Indiana Airport

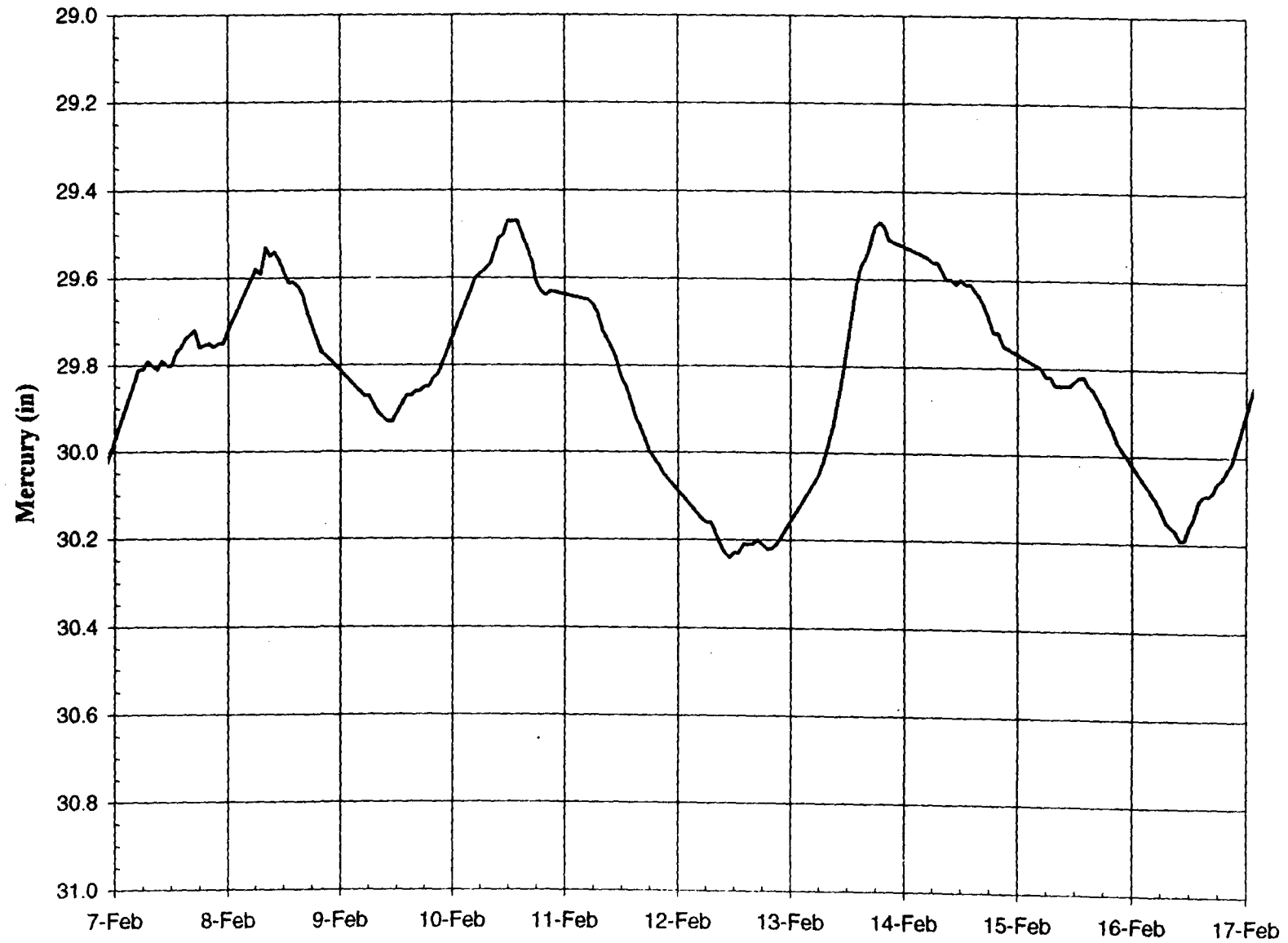
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			Wind	Wind
	Barometer	Air Temp	Speed	Direction
Date / Time	(Inches Hg)	F	mph	(degrees)
Minimum:	29.32	-16	0	0
Maximum:	30.71	60	23	360

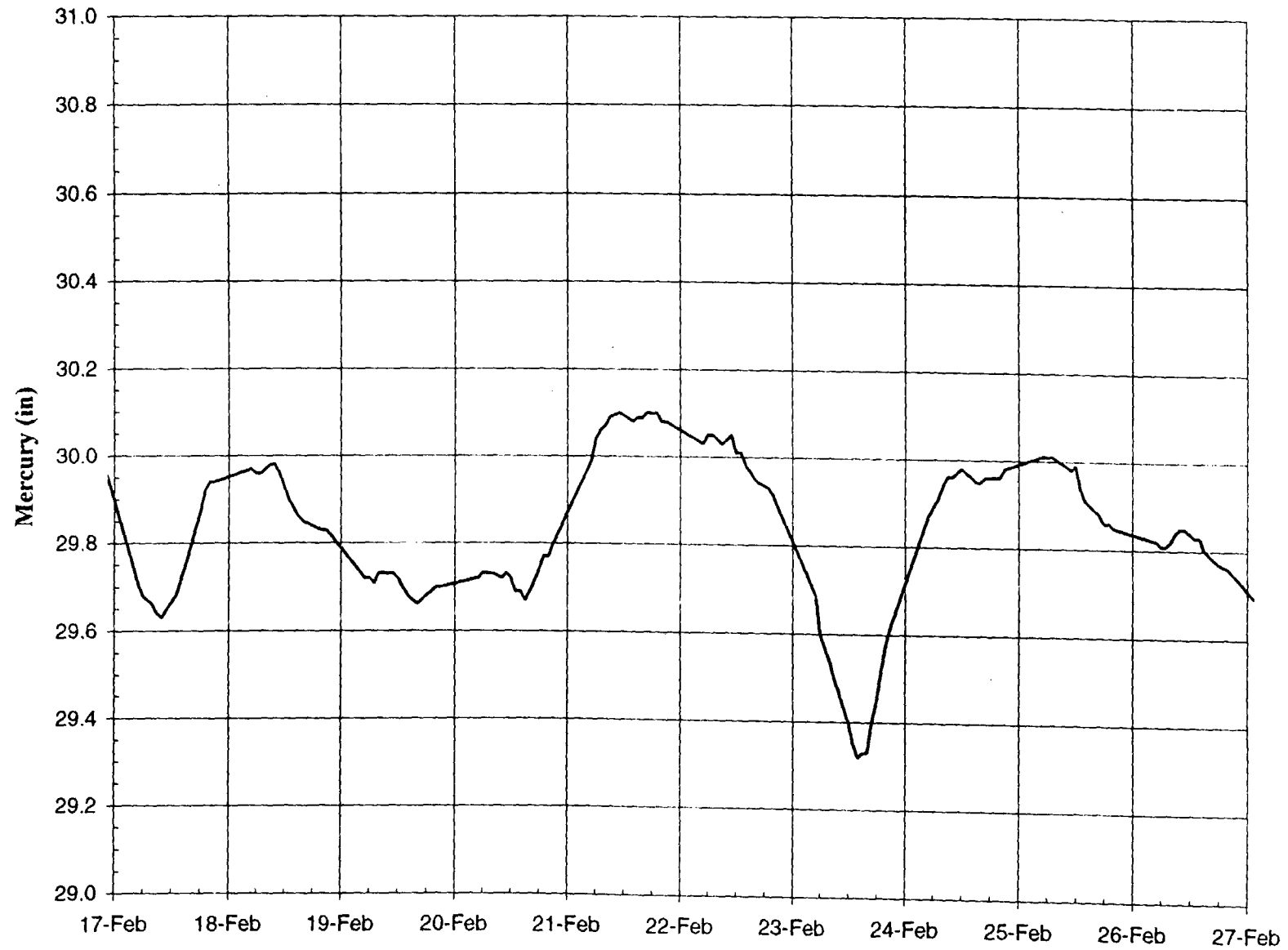
Barometric Pressure, Gary, Indiana



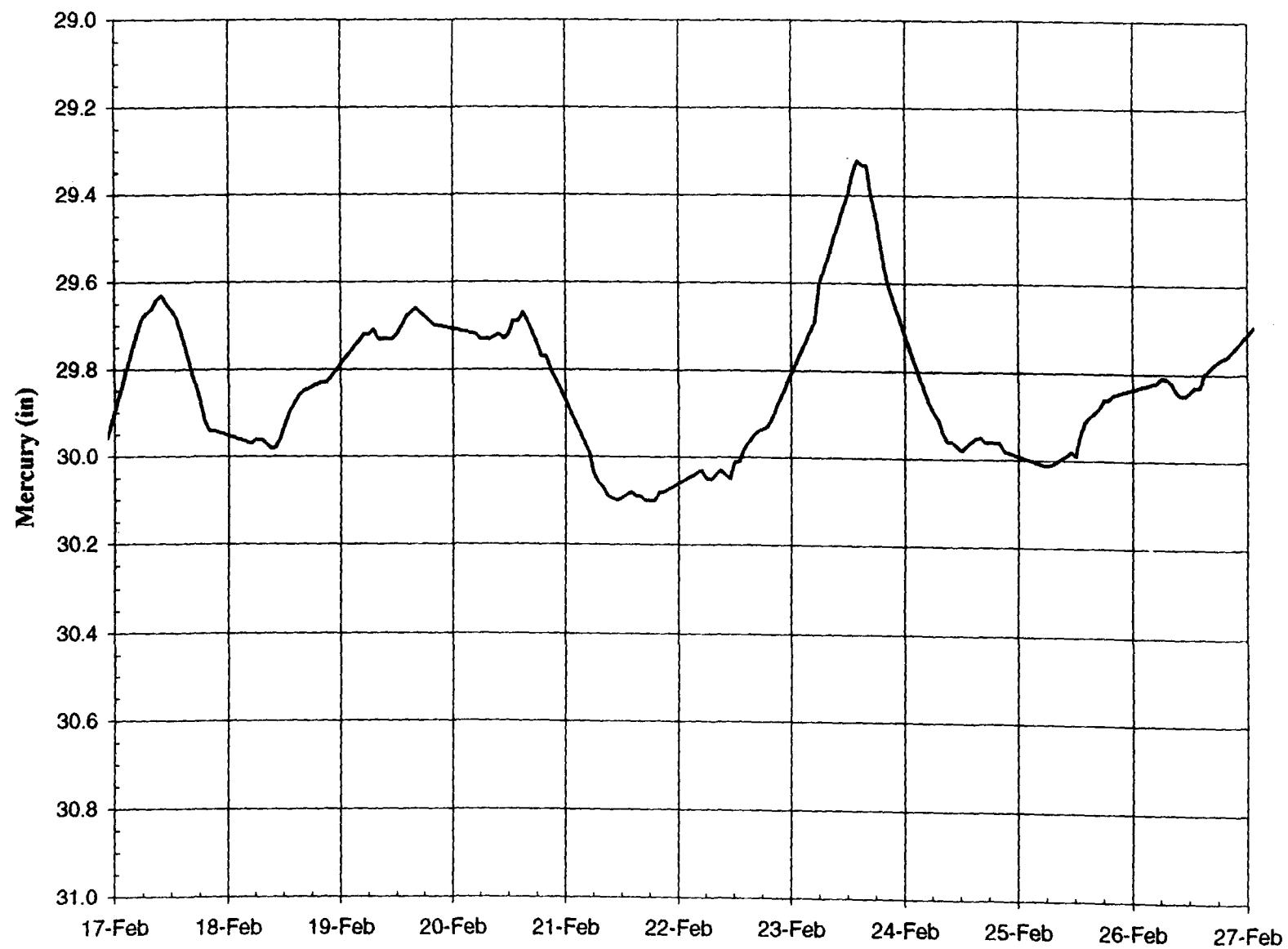
Barometric Pressure, Gary, Indiana



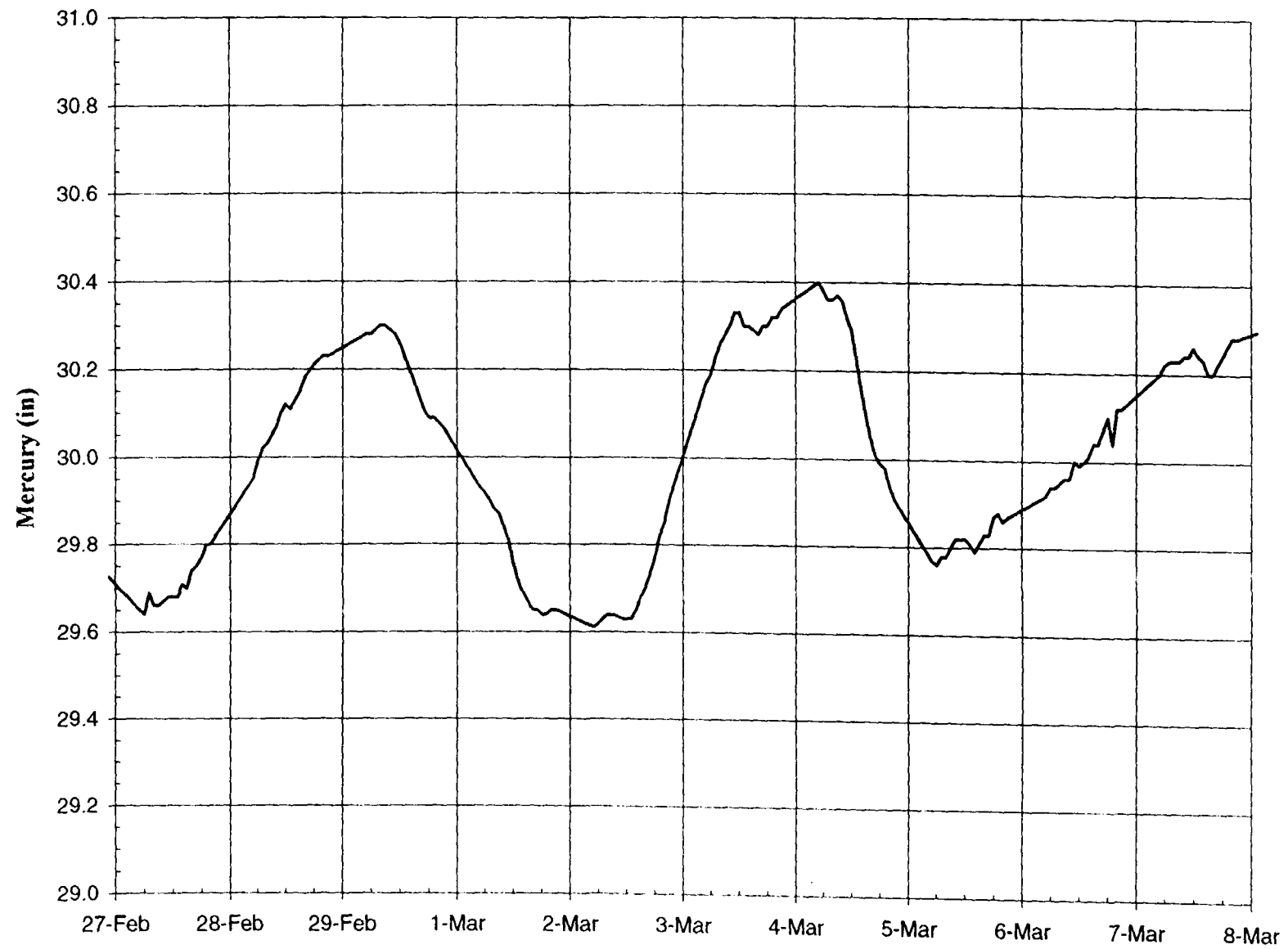
Barometric Pressure, Gary, Indiana



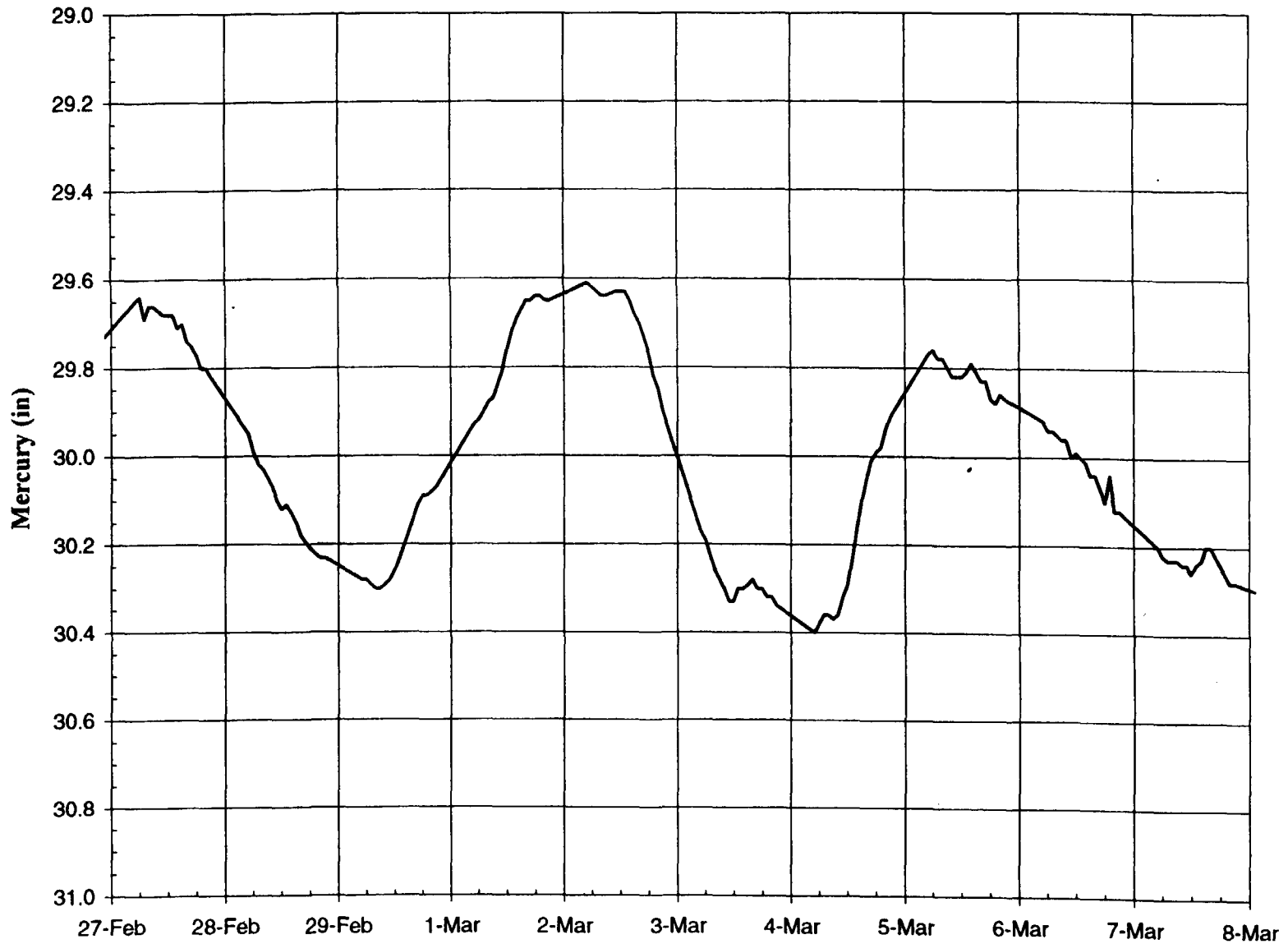
Barometric Pressure, Gary, Indiana



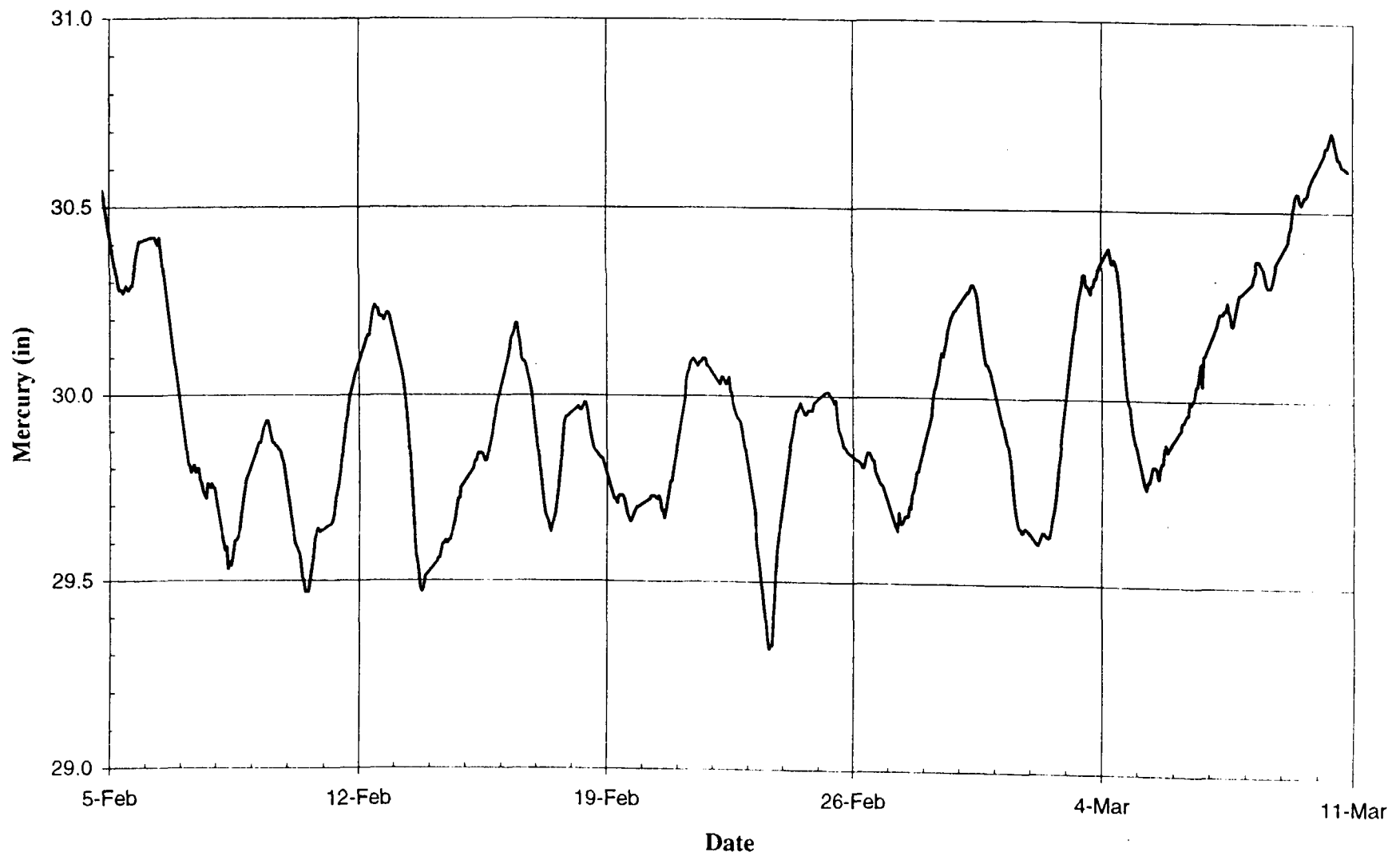
Barometric Pressure, Gary, Indiana



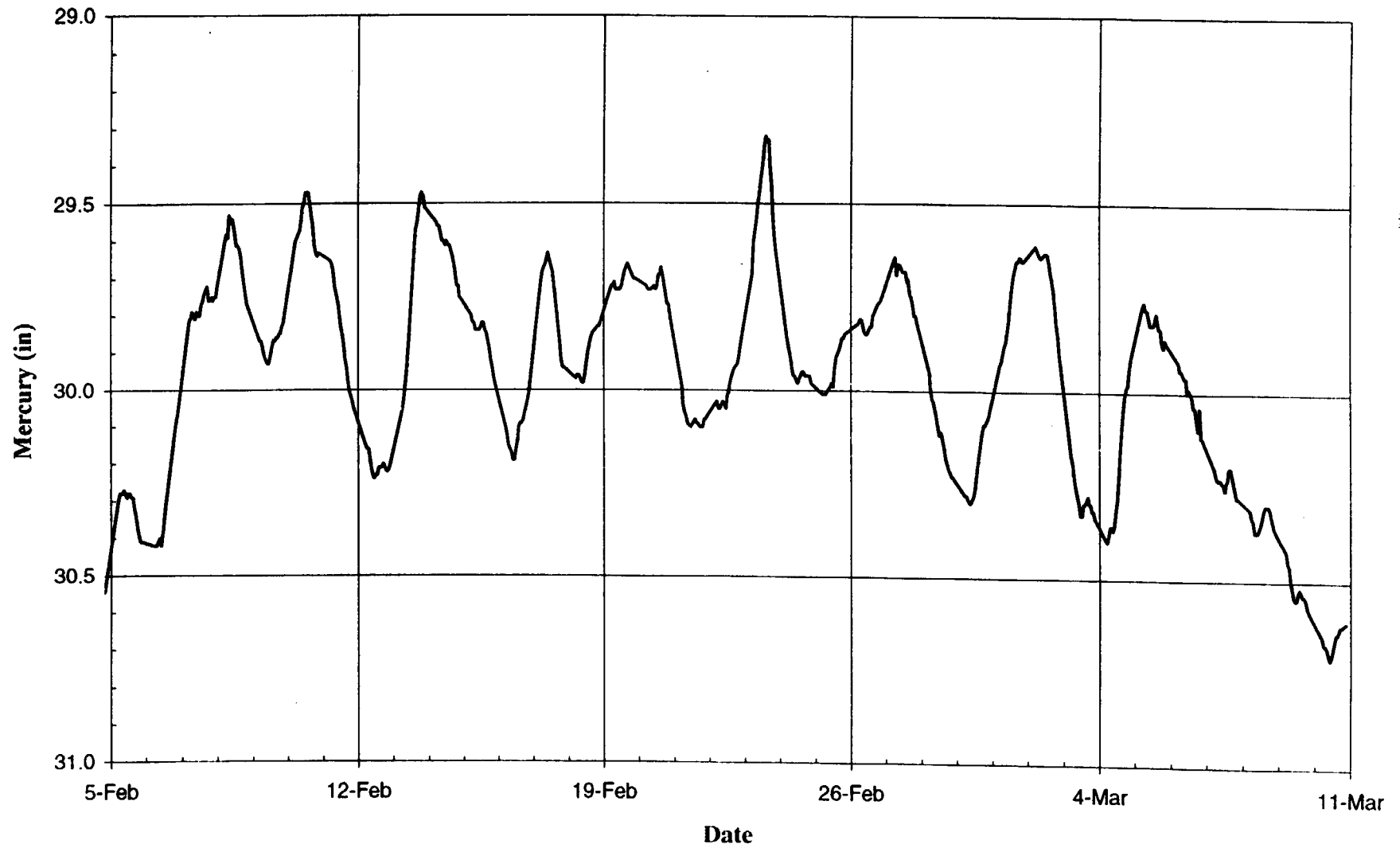
Barometric Pressure, Gary, Indiana



Barometric Pressure, Gary, Indiana



Barometric Pressure, Gary, Indiana



K



K

LABORATORY ANALYTICAL REPORTS
– PRODUCTION WELL SAMPLING

IEA

SDG NARRATIVE VOLATILE FRACTION

PROJECT: 1589-132 (Revision)

BATCH: 02154

METHOD: 1/91 SOW

SAMPLES: Six (6) Water Samples

These samples were received at Industrial and Environmental Analysts, Inc. (IEA) on February 07, 1996. Each sample was assigned a 9-character "IEA" lab identification number (lab ID) and an abbreviated client ID for simplicity in forms generation. This package makes reference to these ID's as listed on the IEA Assigned Number Index. In addition the pH for the water samples are listed on this index. All analyses were performed according to the EPA 1/91 SOW and meet the requirements of the IEA Quality Assurance Program. Please see the enclosed data package for your results and Chain of Custody (COC) documentation.

There is an air peak that is common to all of the volatile analyses and a solvent peak that is common to some volatile analyses. These peaks are present at the beginning of the Reconstructed Ion Chromatograms (RIC) and are labeled. These peaks are not searched as Tentatively Identified Compounds (TIC's).

The chromatographic separation of the analytes is performed using a J & W Scientific 75 m X 0.53 mm DB-624 fused silica capillary column with a 3.0 μ m film thickness.

The trap used in the purge-and-trap apparatus is a Supelco trap K (VOCARB 3000) consisting of 10 cm of Carboxen B, 6 cm of Carboxen 1000, and 1 cm of Carboxen 1001. This trap meets the criteria in the EPA SOW 1/91 for an equivalent trap. Documentation is maintained within the QA department for on-site review.

The "J" flag used on the Form I VOA indicates an estimated concentration between the Contract Required Quantitation Limit (CRQL) and the Method Detection Limit (MDL), not accounting for dilution of the sample prior to analysis. This flag is also used on the Form I VOA-TIC to indicate an estimated amount for all non-target concentrations.

The "N" flag used on the Form I VOA-TIC indicates that there is the presumptive evidence of a compound based on the mass spectral library search and the interpretation of the mass spectral interpretation specialist.

The "B" flag used on the Form I VOA and/or Form I VOA-TIC indicates that this compound was present in the associated method blank.

The "Y" flag is used as a qualifier on the Form I VOA-TIC to indicate a siloxane contaminant attributed to trap breakdown.

IEA

SDG NARRATIVE VOLATILE FRACTION

The "M" flag used on the data system report form designates that a manual integration was required to provide an accurate quantification of that analyte. Manual integrations have been initialled and dated by the analyst.

The following nonconformances associated with the analysis of the samples in this case are as follows:

The samples in this project have a pH of 7 indicating that they were not preserved. A project status report was filed with the client representative to notify the client of this issue.

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the laboratory manager or his designee, as verified by the following signature.

Brian D. Neptune

08/21/96

Brian D. Neptune
Lead Analyst, GC/MS Final Review
IEA, Inc.

3A
WATER VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Name: IEA-NC

Method: SOW 1/91

Lab Code: IEA

Case No.: 1589-132

SDG No.: 02154

Matrix Spike - Client Sample No.: ACS-GWIW3-01

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC #	QC. LIMITS REC.
1,1-Dichloroethene	50	0	59	118	61-145
Trichloroethene	50	0	57	114	71-120
Benzene	50	0	59	118	76-127
Toluene	50	0	56	112	76-125
Chlorobenzene	50	0	56	112	75-130

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC #	% RPD #	QC LIMITS	
					RPD	REC.
1,1-Dichloroethene	50	59	118	0	14	61-145
Trichloroethene	50	57	114	0	14	71-120
Benzene	50	59	118	0	11	76-127
Toluene	50	57	114	2	13	76-125
Chlorobenzene	50	56	112	0	13	75-130

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits.

D Spike compound diluted out.

RPD: 0 out of 5 outside limits

Spike Recovery: 0 out of 10 outside limits

COMMENTS:

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

ACS-GWIW1-01

Lab Name: IEA-NC

Method: SOW 1/91

Lab Code: IEA

Case No.: 1589-132

SDG No.: 02154

Matrix: (soil/water) WATER

Lab Sample ID: 960215401

Sample wt/vol: 5 (g/mL) mL

Lab File ID: 0212E08.D

Level: (low/med) LOW

Date Received: 02/07/96

Moisture: not dec.

Date Analyzed: 02/12/96

GC Column: DB-624 ID: .53(mm)

Dilution Factor: 1.0

Soil Extract Volume: (uL)

Soil Aliquot Volume: (uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/l Q

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg)	ug/l	Q
74-87-3	Chloromethane	10	U	
74-83-9	Bromomethane	10	U	
75-01-4	Vinyl Chloride	10	U	
75-00-3	Chloroethane	10	U	
75-09-2	Methylene Chloride	10	U	
67-64-1	Acetone	14		
75-15-0	Carbon Disulfide	10	U	
75-35-4	1,1-Dichloroethene	10	U	
75-34-3	1,1-Dichloroethane	10	U	
540-89-0	1,2-Dichloroethane (total)	3	J	
67-68-3	Chloroform	10	U	
107-06-2	1,2-Dichloroethane	10	U	
78-93-3	2-Butanone	11		
71-55-6	1,1,1-Trichloroethane	10	U	
56-23-5	Carbon Tetrachloride	10	U	
75-27-4	Bromodichloromethane	10	U	
78-87-5	1,2-Dichloropropane	10	U	
10061-01-5	cis-1,3-Dichloropropene	10	U	
79-01-6	Trichloroethene	5	J	
124-48-1	Dibromochloromethane	10	U	
79-00-8	1,1,2-Trichloroethane	2	J	
71-43-2	Benzene	10	U	
10061-02-6	Trans-1,3-Dichloropropene	10	U	
75-25-2	Bromoform	2	J	
108-10-1	4-Methyl-2-Pentanone	7	J	
591-78-8	2-Hexanone	10	U	
127-18-4	Tetrachloroethene	10	J	
108-88-3	Toluene	10	U	
79-34-5	1,1,2,2-Tetrachloroethane	5	J	
108-90-7	Chlorobenzene	10	U	
100-41-4	Ethylbenzene	10	U	
100-42-5	Styrene	10	U	
1330-20-7	Xylene (total)	10	U	

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

ACS-GWIW1-91

Lab Name: IEA-NC

Method: SOW 1/91

Lab Code: IEA

Case No.: 1589-132

SDG No.: 02154

Matrix: (soil/water) WATER

Lab Sample ID: 960215402

Sample wt/vol: 5 (g/mL) ml

Lab File ID: 0213506.D

Level: (low/med) LOW

Date Received: 02/07/96

% Moisture: not dec.

Date Analyzed: 02/13/96

GC Column: DB-624 ID: .53(mm)

Dilution Factor: 1.0

Soil Extract Volume: (uL)

Soil Aliquot Volume: (uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/l Q

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg)	ug/l	Q
74-87-3	Chloromethane	10	U	
74-83-9	Bromomethane	10	U	
75-01-4	Vinyl Chloride	10	U	
75-00-3	Chloroethane	10	U	
75-09-2	Methylene Chloride	10	U	
67-64-1	Acetone	10	U	
75-18-0	Carbon Disulfide	10	U	
75-35-4	1,1-Dichloroethene	10	U	
75-34-3	1,1-Dichloroethane	10	U	
540-59-0	1,2-Dichloroethane (total)	3	J	
67-66-3	Chloroform	10	U	
107-06-2	1,2-Dichloroethane	10	U	
78-93-3	2-Butanone	10	U	
71-55-6	1,1,1-Trichloroethane	10	U	
56-23-5	Carbon Tetrachloride	10	U	
75-27-4	Bromodichloromethane	10	U	
78-87-5	1,2-Dichloropropane	10	U	
10061-01-5	cis-1,3-Dichloropropene	10	U	
79-01-6	Trichloroethene	5	J	
124-48-1	Dibromochloromethane	10	U	
79-00-5	1,1,2-Trichloroethane	10	U	
71-43-2	Benzene	10	U	
10061-02-6	Trans-1,3-Dichloropropene	10	U	
75-25-2	Bromoform	10	U	
108-10-1	4-Methyl-2-Pentanone	10	U	
591-78-6	2-Hexanone	10	U	
127-18-4	Tetrachloroethene	10		
108-88-3	Toluene	10	U	
79-34-5	1,1,2,2-Tetrachloroethane	10	U	
108-90-7	Chlorobenzene	10	U	
100-41-4	Ethylbenzene	10	U	
100-42-5	Styrene	10	U	
1330-20-7	Xylene (total)	10	U	

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

ACS-GWIW2-01

Lab Name: IEA-NC

Method: SOW 1/91

Lab Code: IEA

Case No.: 1589-132

SDG No.: 02154

Matrix: (soil/water) WATER

Lab Sample ID: 960215403

Sample wt/vol: 5 (g/mL) ml

Lab File ID: 0212E10.D

Level: (low/med) LOW

Date Received: 02/07/96

† Moisture: not dec.

Date Analyzed: 02/13/96

GC Column: DB-624 ID: .53(mm)

Dilution Factor: 1.0

Soil Extract Volume: (uL)

Soil Aliquot Volume: (uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/l Q

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg)	ug/l	Q
74-87-3	Chloromethane		10	U
74-83-9	Bromomethane		10	U
75-01-4	Vinyl Chloride		10	U
78-00-3	Chloroethane		10	U
75-09-2	Methylene Chloride		10	U
67-64-1	Acetone		10	U
75-15-0	Carbon Disulfide		10	U
75-35-4	1,1-Dichloroethene		10	U
75-34-3	1,1-Dichloroethane		10	U
540-59-0	1,2-Dichloroethene (total)		10	U
67-66-3	Chloroform		10	U
107-06-2	1,2-Dichloroethane		10	U
78-93-3	2-Butanone		10	U
71-55-8	1,1,1-Trichloroethane		10	U
56-23-5	Carbon Tetrachloride		10	U
75-27-4	Bromodichloromethane		10	U
78-87-5	1,2-Dichloropropane		10	U
10061-01-5	cis-1,3-Dichloropropene		10	U
79-01-6	Trichloroethene		10	U
124-48-1	Dibromochloromethane		10	U
79-00-5	1,1,2-Trichloroethane		10	U
71-43-2	Benzene		10	U
10061-02-6	Trans-1,3-Dichloropropene		10	U
75-25-2	Bromoform		10	U
108-10-1	4-Methyl-2-Pentanone		10	U
591-78-6	2-Hexanone		10	U
127-18-4	Tetrachloroethene		10	U
108-88-3	Toluene		10	U
79-34-5	1,1,2,2-Tetrachloroethane		10	U
108-90-7	Chlorobenzene		10	U
100-41-4	Ethylbenzene		10	U
100-42-5	Styrene		10	U
1330-20-7	Xylenes (total)		10	U

FORM I VOA

CLIENT SAMPLE NO.

ACS-GWIW2-01

Lab Name: IEA-NC

Method: SOW 1/91

Lab Code: IEA

Case No. : 1589-132

SDG No. : 02154

Matrix: (soil/water) WATER

Lab Sample ID: 960215403

Sample wt/vol: 5 (g/mL) ml

Lab File ID: 0212E10.D

Level: (low/med) LOW

Date Received: 02/07/96

* Moisture: not dec.

Date Analyzed: 02/13/96

GC Column: DB-624 ID: .53 (mm)

Dilution Factor: 1.0

Soil Extract Volume: (uL)

Soil Aliquot Volume: (uL)

Number TICs Found: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/l

[illegible]

FORM I VOA-TIC

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

ACS-GWIW3-01

Lab Name: IEA-NC

Method: SOW 1/91

Lab Code: IEA

Case No.: 1589-132

SDG No.: 02154

Matrix: (soil/water) WATER

Lab Sample ID: 960215404

Sample wt/vol: 5 (g/mL) ml

Lab File ID: 0212E11.D

Level: (low/med) LOW

Date Received: 02/07/96

% Moisture: not dec.

Date Analyzed: 02/13/96

GC Column: DB-624 ID: .53(mm)

Dilution Factor: 1.0

Soil Extract Volume: (uL)

Soil Aliquot Volume: (uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/l Q

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg)	ug/l	Q
74-87-3	Chloromethane	10	U	
74-83-9	Bromomethane	10	U	
75-01-4	Vinyl Chloride	10	U	
75-00-3	Chloroethane	10	U	
75-09-2	Methylene Chloride	10	U	
67-64-1	Acetone	10	U	
75-15-0	Carbon Disulfide	10	U	
75-35-4	1,1-Dichloroethane	10	U	
75-34-3	1,1-Dichloroethane	10	U	
540-59-0	1,2-Dichloroethane (total)	10	U	
67-66-3	Chloroform	10	U	
107-06-2	1,2-Dichloroethane	10	U	
78-93-3	2-Butanone	10	U	
71-55-6	1,1,1-Trichloroethane	10	U	
56-23-5	Carbon Tetrachloride	10	U	
75-27-4	Bromodichloromethane	10	U	
78-87-5	1,2-Dichloropropane	10	U	
10061-01-5	cis-1,3-Dichloropropene	10	U	
79-01-8	Trichloroethane	10	U	
124-48-1	Dibromochloromethane	10	U	
79-00-5	1,1,2-Trichloroethane	10	U	
71-43-2	Benzene	10	U	
10061-02-6	Trans-1,3-Dichloropropene	10	U	
78-25-2	Bromoform	10	U	
108-10-1	4-Methyl-2-Pentanone	10	U	
591-78-6	2-Hexanone	10	U	
127-18-4	Tetrachloroethane	10	U	
108-88-3	Toluene	10	U	
75-34-5	1,1,2,2-Tetrachloroethane	10	U	
108-90-7	Chlorobenzene	10	U	
100-41-4	Ethylbenzene	10	U	
100-42-5	Styrene	10	U	
1330-20-7	Xylene (total)	10	U	

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

ACS-GWIW4-01

Lab Name: IEA-NC

Method: SOW 1/91

Lab Code: IEA

Case No.: 1589-132

SDG No.: 02154

Matrix: (soil/water) WATER

Lab Sample ID: 960215405

Sample wt/vol: 5 (g/mL) mL

Lab File ID: 0213505.D

Level: (low/med) LOW

Date Received: 02/07/96

% Moisture: not dec.

Date Analyzed: 02/13/96

GC Column: DB-624 ID: .53(mm)

Dilution Factor: 1.0

Soil Extract Volume: (uL)

Soil Aliquot Volume: (uL)

CONCENTRATION UNITS:

(ug/L or ug/Kg)

ug/l

Q

CAS NO.	COMPOUND		
74-87-3	Chloromethane	10	U
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	10	U
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	10	U
75-35-4	1,1-Dichloroethane	10	U
75-34-3	1,1-Dichloroethane	10	U
540-59-0	1,2-Dichloroethane (total)	10	U
67-66-3	Chloroform	10	U
107-06-2	1,2-Dichloroethane	10	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	10	U
56-23-5	Carbon Tetrachloride	10	U
75-27-4	Bromodichloromethane	10	U
78-87-5	1,2-Dichloropropane	10	U
10061-01-5	cis-1,3-Dichloropropene	10	U
79-01-6	Trichloroethene	10	U
124-48-1	Dibromochloromethane	10	U
79-00-5	1,1,2-Trichloroethane	10	U
71-43-2	Benzene	10	U
10061-02-6	Trans-1,3-Dichloropropene	10	U
75-25-2	Bromoform	10	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	10	U
108-88-3	Toluene	1	J
79-34-5	1,1,2,2-Tetrachloroethane	10	U
108-90-7	Chlorobenzene	10	U
100-41-4	Ethylbenzene	4	J
100-42-5	Styrene	10	U
1330-20-7	Xylene (total)	13	

FORM I VOA

Figure 1

-2-

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

ACS-GWIW4-01

Method: SOW 1/91

SDG No.: 02154

Lab Sample ID: 960215405

Lab File ID: 0213505.D

Date Received: 02/07/96

Date Analyzed: 02/13/96

Dilution Factor: 1.0

Soil Aliquot Volume: (uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/l

[illegible]

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

ACS-GWITB-01

Lab Name: IEA-NC

Method: SOW 1/91

Lab Code: IEA

Case No.: 1589-132

SDG No.: 02154

Matrix: (soil/water) WATER

Lab Sample ID: 960215406

Sample wt/vol: 5 (g/mL) ml

Lab File ID: 0213504.D

Level: (low/med) LOW

Date Received: 02/07/96

% Moisture: not dec.

Date Analyzed: 02/13/96

GC Column: DB-624 ID: .53(mm)

Dilution Factor: 1.0

Soil Extract Volume: (uL)

Soil Aliquot Volume: (uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/l Q

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg)	ug/l	Q
74-87-3	Chloromethane		10	U
74-83-9	Bromomethane		10	U
75-01-4	Vinyl chloride		10	U
75-00-3	Chloroethane		10	U
75-09-2	Methylene Chloride		10	U
67-64-1	Acetone		10	U
75-15-0	Carbon Disulfide		10	U
75-35-4	1,1-Dichloroethane		10	U
75-34-3	1,1-Dichloroethane		10	U
540-59-0	1,2-Dichloroethane (total)		10	U
67-86-3	Chloroform		10	U
107-06-2	1,2-Dichloroethane		10	U
78-93-3	2-Butanone		10	U
71-55-6	1,1,1-Trichloroethane		10	U
56-23-5	Carbon Tetrachloride		10	U
75-27-4	Bromodichloromethane		10	U
78-87-5	1,2-Dichloropropane		10	U
10061-01-5	cis-1,3-Dichloropropene		10	U
79-01-6	Trichloroethane		10	U
124-48-1	Dibromochloromethane		10	U
79-00-5	1,1,2-Trichloroethane		10	U
71-43-2	Benzene		10	U
10061-02-6	Trans-1,3-Dichloropropene		10	U
75-25-2	Bromoform		10	U
108-10-1	4-Methyl-2-Pentanone		10	U
591-78-6	2-Hexanone		10	U
127-18-4	Tetrachloroethane		10	U
108-88-3	Toluene		10	U
79-34-5	1,1,2,2-Tetrachloroethane		10	U
108-90-7	Chlorobenzene		10	U
100-41-4	Ethylbenzene		10	U
100-42-5	Styrene		10	U
1330-20-7	Xylene (total)		10	U

FORM I VOA

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

CLIENT SAMPLE NO.

ACS-GWITB-01

Lab Name: IEA-NC

Method: SOW 1/91

Lab Code: IEA

Case No.: 1589-132

SDG No.: 02154

Matrix: (soil/water) WATER

Lab Sample ID: 960215406

Sample wt/vol: 5 (g/mL) ml

Lab File ID: 0213504.D

Level: (low/med) LOW

Date Received: 02/07/96

* Moisture: not dec.

Date Analyzed: 02/13/96

GC Column: DB-624 ID: .53 (mm)

Dilution Factor: 1.0

Soil Extract Volume: (uL)

Soil Aliquot Volume: (uL)

Number TICs Found: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/l

[illegible]

FORM I VOA-TIC

1E

CLIENT SAMPLE NO.

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

ACS-GWIW3-01

Lab Name: IEA-NC

Method: SOW 1/91

Lab Code: IEA

Case No. : 1589-132

SDG No.: 02154

Matrix: (soil/water) WATER

Lab Sample ID: 960215404

Sample wt/vol: 5 (g/mL) ml

Lab File ID: 0212E11.D

Level: (low/med) LOW

Date Received: 02/07/96

‡ Moisture: not dec.

Date Analyzed: 02/13/96

GC Column: DB-624 ID: .53 (mm)

Dilution Factor: 1.0

Soil Extract Volume: (uL)

Soil Aliquot Volume: (uL)

Number TICs Found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/l

[illegible]

FORM I VOA-TIC

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

ACS-GWIW3-01MS

Lab Name: IEA-NC

Method: SOW 1/91

Lab Code: IEA

Case No.: 1589-132

SDG No.: 02154

Matrix: (soil/water) WATER

Lab Sample ID: 960215404MS

Sample wt/vol: 5 (g/mL) ml

Lab File ID: 0212E12.D

Level: (low/med) LOW

Date Received: 02/07/96

Moisture: not dec.

Date Analyzed: 02/13/96

GC Column: DB-624 ID: .53(mm)

Dilution Factor: 1.0

Soil Extract Volume: (uL)

Soil Aliquot Volume: (uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/l Q

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg)	ug/l	Q
74-87-3	Chloromethane	10	U	
74-83-9	Bromomethane	10	U	
75-01-4	Vinyl Chloride	10	U	
75-00-3	Chloroethane	10	U	
75-09-2	Methylene Chloride	10	U	
67-64-1	Acetone	10	U	
78-15-0	Carbon Disulfide	10	U	
75-35-4	1,1-Dichloroethane	59		
75-34-3	1,1-Dichloroethane	10	U	
540-59-0	1,2-Dichloroethane (total)	10	U	
67-66-3	Chloroform	10	U	
107-06-2	1,2-Dichloroethane	10	U	
78-93-3	2-Butanone	10	U	
71-55-6	1,1,1-Trichloroethane	10	U	
56-23-5	Carbon Tetrachloride	10	U	
75-27-4	Bromodichloromethane	10	U	
78-87-5	1,2-Dichloropropane	10	U	
10061-01-5	cis-1,3-Dichloropropane	10	U	
79-01-6	Trichloroethane	57		
124-48-1	Dibromochloromethane	10	U	
79-00-5	1,1,2-Trichloroethane	10	U	
71-43-2	Benzene	59		
10061-02-6	Trans-1,3-Dichloropropane	10	U	
75-25-2	Bromoform	10	U	
108-10-1	4-Methyl-2-Pentanone	10	U	
591-78-6	2-Hexanone	10	U	
127-18-4	Tetrachloroethane	10	U	
108-88-3	Toluene	56		
79-34-5	1,1,2,2-Tetrachloroethane	10	U	
108-90-7	Chlorobenzene	56		
100-41-4	Ethylbenzene	10	U	
100-42-5	Styrene	10	U	
1330-20-7	Xylene (total)	10	U	

FORM I VOA

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

ACS-GWIW3-01MSD

Lab Name: IEA-NC

Method: SOW 1/91

Lab Code: IEA

Case No.: 1589-132

SDG No.: 02154

Matrix: (soil/water) WATER

Lab Sample ID: 960215404MSD

Sample wt/vol: 5 (g/mL) ml

Lab File ID: 0212E13.D

Level: (low/med) LOW

Date Received: 02/07/96

% Moisture: not dec.

Date Analyzed: 02/13/96

GC Column: DB-624 ID: .53(mm)

Dilution Factor: 1.0

Soil Extract Volume: (uL)

Soil Aliquot Volume: (uL)

CAS NO.

COMPOUND

CONCENTRATION UNITS:

(ug/L or ug/Kg)

ug/l

Q

74-87-3	Chloromethane	10	U
74-83-9	Bromomethane	10	U
75-01-4	Vinyl Chloride	10	U
75-00-3	Chloroethane	10	U
75-09-2	Methylene Chloride	10	U
67-64-1	Acetone	10	U
75-15-0	Carbon Disulfide	10	U
75-35-4	1,1-Dichloroethane	59	U
75-34-3	1,1-Dichloroethane	10	U
540-59-0	1,2-Dichloroethane (total)	10	U
67-66-3	Chloroform	10	U
107-06-2	1,2-Dichloroethane	10	U
78-93-3	2-Butanone	10	U
71-55-6	1,1,1-Trichloroethane	10	U
56-23-5	Carbon Tetrachloride	10	U
75-27-4	Bromodichloromethane	10	U
78-87-5	1,2-Dichloropropane	10	U
10061-01-5	cis-1,3-Dichloropropene	10	U
79-01-6	Trichloroethene	57	U
124-48-1	Dibromochloromethane	10	U
79-00-5	1,1,2-Trichloroethane	10	U
71-43-2	Benzene	59	U
10061-02-6	Trans-1,3-Dichloropropene	10	U
75-25-2	Bromoform	10	U
108-10-1	4-Methyl-2-Pentanone	10	U
591-78-6	2-Hexanone	10	U
127-18-4	Tetrachloroethene	10	U
108-88-3	Toluene	57	U
79-34-5	1,1,2,2-Tetrachloroethane	10	U
108-90-7	Chlorobenzene	56	U
100-41-4	Ethylbenzene	10	U
100-42-5	Styrene	10	U
1330-20-7	Xylene (total)	10	U

FORM I VOA

3A

WATER VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Name: IEA-NC

Method: SOW 1/91

Lab Code: IEA

Case No.: 1589-132

SDG No.: 02154

Matrix Spike - Client Sample No.: ACS-GWIW3-01

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC #	QC. LIMITS REC.
1,1-Dichloroethene	50	0	59	118	61-145
Trichloroethene	50	0	57	114	71-120
Benzene	50	0	59	118	76-127
Toluene	50	0	56	112	76-125
Chlorobenzene	50	0	56	112	75-130

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC #	% RPD #	QC LIMITS	
					RPD	REC.
1,1-Dichloroethene	50	59	118	0	14	61-145
Trichloroethene	50	57	114	0	14	71-120
Benzene	50	59	118	0	11	76-127
Toluene	50	57	114	2	13	76-125
Chlorobenzene	50	56	112	0	13	75-130

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits.

D Spike compound diluted out.

RPD: 0 out of 5 outside limits

Spike Recovery: 0 out of 10 outside limits

COMMENTS:

L



Table 12
Summary of Organic Analytical Detects
Private Well Investigation
American Chemical Services, Inc.
Griffith, Indiana

		APD-GWPW01-01 ¹ 7/17/96			APD-GWPW01-91 7/17/96			APD-GWPW02-01 ² 7/17/96			APD-GWPW03-01 7/17/96			APD-GWPW04-01 7/17/96			APD-PWTB01-01 7/17/96		
Analyte	CAS No.	ug/L	LQ/DVQ	RDL	ug/L	LQ/DVQ	RDL	ug/L	LQ/DVQ	RDL	ug/L	LQ/DVQ	RDL	ug/L	LQ/DVQ	RDL	ug/L	LQ/DVQ	RDL
VOLATILES																			
Chloromethane	74-87-3		U/	1		U/	1		J/U	1		J/U	1		U/	1	0.1	J/	1
Chloroethane	75-00-3		U/	1		U/	1	21	/	1		U/	1		U/	1		U/	1
Methylene chloride	75-09-2		U/	2		U/	2		J/U	2		J/U	2		U/	2	0.6	J/	2
Acetone	67-64-1		J/R	5		J/R	5		U/R	5		/R	5		J/R	5	5	J/R	5
Chloroform	67-66-3		U/	1		U/	1		U/	1		U/	1	0.2	J/	1		U/	1
1,2-Dichloroethane	107-06-2		J/U	1		J/U	1		J/U	1		J/U	1		U/	1	0.7	J/	1
Benzene	71-43-2		U/	1		U/	1	1	/	1		U/	1		U/	1		U/	1
Toluene	108-88-3		U/	1		U/	1	0.1	J/	1		U/	1		U/	1		U/	1
SEMIVOLATILES																			
bis(2-Chloroethyl) ether	111-44-4							3	J/	10		U/	10		U/	10			
Carbazole	86-74-8							2	J/	10		U/	10		U/	10			
bis(2-Ethylhexyl)phthalate	117-81-7							12	/	10		U/	10		U/	10			

Notes:

This table presents a summary of the validated analytical results for compounds detected in at least one private well samples collected in July 1996. Volatiles analysis was performed using the low concentration SOW, semivolatile and PCB analysis was performed using the routine concentration SOW. PCBs were not detected in any of the samples.

Analytical results are presented in units of ug/L.

LQ/DVQ = Laboratory Qualifier / Data Validation Qualifier, as defined in the appropriate SOW.

RDL = reported detection limit.

Footnotes

1. Semivolatile and PCB analysis was not performed on samples PW01-01 and PW01-91 because the samples were lost during shipping.
2. This well is not used for drinking water. The residence has a public water supply.

Table 13
Inorganic Analytical Report
Private Well Investigation
American Chemical Services, Inc.
Griffith, Indiana

Analyte	CAS No.	APD-GWPW01-01						APD-GWPW01-91						APD-GWPW02-01					
		Total 7/17/96			Dissolved 7/17/96			Total 7/17/96			Dissolved 7/17/96			Total 7/17/96			Dissolved 7/17/96		
		ug/L	LQ/DVQ	RDL	ug/L	LQ/DVQ	RDL	ug/L	LQ/DVQ	RDL	ug/L	LQ/DVQ	RDL	ug/L	LQ/DVQ	RDL	ug/L	LQ/DVQ	RDL
Aluminum	7429-90-5		B/U	79.0		B*/UJ	80.0		B/U	59.0		U*/UJ	50.0		U/	50.0	732	*/J	50.0
Antimony	7440-36-0		U/	2.0		U/	2.0		U/	2.0		U/	2.0		U/	2.0		U/	2.0
Arsenic	7440-38-2		U/	1.0		U/	1.0		U/	1.0		U/	1.0	1.0	B/	1.0	1.0	B/	1.0
Barium	7440-39-3	132	B/	10.0	122	B/	10.0	126	B/	10.0	130	B/	10.0	594	/	10.0	632	/	10.0
Beryllium	7440-41-7		U/	0.20		U/	0.20		U/	0.20		U/	0.20		U/	0.20		U/	0.20
Cadmium	7440-43-9		U/	0.20		U/	0.20		U/	0.20		U/	0.20		U/	0.20		U/	0.20
Calcium	7440-70-2	79700	/	1000	81500	/	1000	80500	/	1000		U/	1000	90800	/	1000	85200	/	1000
Chromium, total	7440-47-3		U/	10.0		U/	10.0		U/	10.0		U/	10.0		U/	10.0		U/	10.0
Cobalt	7440-48-4		U/	50.0		U/	50.0		U/	50.0		U/	50.0		U/	50.0		U/	50.0
Copper	7440-50-8	14.5	B/	10.0		U/	10.0	11.5	B/	10.0		U/	10.0	12.5	B/	10.0	10.0	B/	10.0
Iron	7439-89-6	3650	/	20.0	2730	*/J	20.0	3550	/	20.0	2890	*/J	20.0	3850	/	20.0	3190	*/J	20.0
Lead	7439-92-1		U/	1.5		U/	1.5		U/	1.5		U/	1.5		U/	1.5		U/	1.5
Magnesium	7439-95-4	40600	/	1000	43300	/	1000	41600	/	1000	42000	/	1000	75300	/	1000	74400	/	1000
Manganese	7439-96-5	40.5	/	10.0	35.5	/	10.0	33.0	/	10.0	41.5	/	10.0	122	/	10.0	160	/	10.0
Mercury	7439-97-6		U/	0.20		U/	0.20		U/	0.20		U/	0.20		U/	0.20		U/	0.20
Nickel	7440-02-0		U/	20.0		U/	20.0		U/	20.0		U/	20.0	51.0	/	20.0	51.5	/	20.0
Potassium	7440-09-7	2220	B/	100	2330	B/	100	2350	/	100	2510	B/	100	72800	/	100	74400	/	100
Selenium	7782-49-2		U/	2.0		U/	2.0		U/	2.0		U/	2.0		U/	2.0		U/	2.0
Silver	7440-22-4		U/	10.0		U/	10.0		U/	10.0		U/	10.0		U/	10.0	10.5	/	10.0
Sodium	7440-23-5	19800	/	2000	23200	/	2000	18400	U/	2000	27100	/	2000	1390000	/	2000	1490000	/	2000
Thallium	7440-28-0		U/	1.0		U/	1.0		U/	1.0		U/	1.0		U/	1.0		U/	1.0
Vanadium	7440-62-2		U/	20.0		U/	20.0		U/	20.0		U/	20.0		U/	20.0		U/	20.0
Zinc	7440-66-6		U/	39.0		B/U	14.5		U/	34.5		U/	21.0		B/U	15.5		B/U	19.5

Table 13
Inorganic Analytical Report
Private Well Investigation
American Chemical Services, Inc.
Griffith, Indiana

Analyte	CAS No.	APD-GWPW03-01						APD-GWPW04-01					
		Total 7/17/96			Dissolved 7/17/96			Total 7/17/96			Dissolved 7/17/96		
		ug/L	LQ/DVQ	RDL	ug/L	LQ/DVQ	RDL	ug/L	LQ/DVQ	RDL	ug/L	LQ/DVQ	RDL
Aluminum	7429-90-5		B/U	72.0		*A/U	50.0		B/U	70.0	166	B*/U	50.0
Antimony	7440-36-0		U/	2.0		U/	2.0		U/	2.0		U/	2.0
Arsenic	7440-38-2		U/	1.0		U/	1.0		U/	1.0		U/	1.0
Barium	7440-39-3	25	B/	10.0	22.5	B/	10.0		U/	10.0	10.0	B/	10.0
Beryllium	7440-41-7		U/	0.20		U/	0.20		U/	0.20		U/	0.20
Cadmium	7440-43-9		U/	0.20		U/	0.20		U/	0.20		U/	0.20
Calcium	7440-70-2	69800	/	1000	75600	/	1000	44200	/	1000	42600	/	1000
Chromium, total	7440-47-3		U/	10.0		U/	10.0		U/	10.0		U/	10.0
Cobalt	7440-48-4		U/	50.0		U/	50.0		U/	50.0		U/	50.0
Copper	7440-50-8	21	B/	10.0	33.0	/	10.0		U/	10.0	15.0	B/	10.0
Iron	7439-89-6		U/	20.0		U*/U	20.0		U/	20.0		B*/U	46.5
Lead	7439-92-1		U/	1.5		U/	1.5		U/	1.5		U/	1.5
Magnesium	7439-95-4	29200	/	1000	29700	/	1000	16400	/	1000	16600	/	1000
Manganese	7439-96-5		U/	10.0		U/	10.0		U/	10.0		U/	10.0
Mercury	7439-97-6		U/	0.20		U/	0.20		U/	0.20		U/	0.20
Nickel	7440-02-0		U/	20.0		U/	20.0		U/	20.0		U/	20.0
Potassium	7440-09-7	7800	/	100	7930	/	100	2420	B/	100	2450	B/	100
Selenium	7782-49-2		U/	2.0		US/	2.0		US/	2.0		US/	2.0
Silver	7440-22-4		U/	10.0		U/	10.0		U/	10.0		U/	10.0
Sodium	7440-23-5	35700	/	2000	38100	/	2000	9280	/	2000	9080	/	2000
Thallium	7440-28-0		U/	1.0		U/	1.0		U/	1.0		U/	1.0
Vanadium	7440-62-2		U/	20.0		U/	20.0		U/	20.0		U/	20.0
Zinc	7440-66-6	127	/	10.0	146	/	10.0		A/	54.5		A/	51.5

Notes:

This table presents the validated analytical results of private well samples collected in July 1996. Metals analysis was performed using the routine concentration SOW.

Analytical results are presented in units of ug/L.

LQ/DVQ = Laboratory Qualifier / Data Validation Qualifier, as defined in the appropriate SOW and Function Guidelines.

RDL = reported detection limit.

**Proposed Lower Aquifer Monitoring Plan
American Chemical Service, Inc.
Griffith, Indiana**

[illegible]

Notes:

TCL Target Compound List (VOCs, SVOCs, pesticides & PCBs)

TAL Target Analyte List (Metals)

III. Target Indicator List (benzene, chloroethane, ethylbenzene, toluene, xylene, chlorobenzene, 1,2-dichloroethene, and 1,1-dichloroethane)

Table 6
Vertical Gradient Calculations
Lower Aquifer Investigation
American Chemical Service, Inc.
Griffith, Indiana

Well Nest	Screen Interval		Screen Midpoint	Separation (feet)	Groundwater Elevation				Vertical Gradients In Lower Aquifer		
	Top	Bottom			Upper	Middle	Lower	delta	Upper/Middle	Middle/Lower	Upper/Lower
MW7	595.9	590.9	593.4		622.4						
PZ44	578.4	573.4	575.9	18		622.37		-0.03	-0.002		
MW36	552.7	542.7	547.7	28			622.36	-0.01		-0.0004	-0.0009
MW8	598.2	593.2	595.7		621.98						
MW31	574.6	564.6	569.6	26		621.96		-0.02	-0.0008		
MW32	547.3	537.3	542.3	27			621.98	0.02		0.0007	0.0000
MW9	605.9	600.9	603.4		622.29						
MW29	585.9	575.9	580.9	23		622.26		-0.03	-0.001		
MW34	552.8	542.8	547.8	33			622.28	0.02		0.0006	-0.0002
MW10	603.0	598.0	600.5		621.86						
MW30	585.0	575.0	580.0	21		621.75		-0.11	-0.005		
MW33	556.0	546.0	551.0	29			621.77	0.02		0.0007	-0.002
MW28	588.7	578.7	583.7		622.97						
PZ42	568.5	563.5	566.0	18		622.95		-0.02	-0.001		
PZ43	554.5	549.5	552.0	14			622.99	0.04		0.003	0.0006
M4	586.42	581.42	583.92		NA						
MW35	551.8	541.8	546.8				622.46				NA

Notes:

(-) = Downward Vertical Gradient

(+) = Upward Vertical Gradient

Water Levels Collected by Montgomery Watson on March 15, 1996

NA = Not Applicable. Water elevations for the City of Griffith Landfill well M-4 were not available.

Table 8

**Summary of Metals Detections
Lower Aquifer Investigation
American Chemical Service, Inc.
Griffith, Indiana**

	Remediation Level (ug/L.)	APD-GW-RINSATE						APD-GW-MW28					
		Total	LQ/DVQ	RDL	Dissolved	LQ/DVQ	RDL	Total	LQ/DVQ	RDL	Dissolved	LQ/DVQ	RDL
Aluminum			U/	13.0		U/	13.0		B/U	27.2		U/	13.0
Antimony			U/	2.0		U/	2.0		U/	2.0		U/	2.0
Arsenic			U/	3.0		U/	3.0		U/	3.0		U/	3.0
Barium			U/	1.0		UE/	1.0	95.1	B/	1.0	95.7	BE/	1.0
Beryllium			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Cadmium			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Calcium			B/U	121		B/U	228	79400	/	18.0	79700	/	18.0
Chromium			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Cobalt			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Copper		14.0	B/	1.0		B/U	1.9		U/	1.0		U/	1.0
Iron			U/	8.0		UE/	8.0	1840	/	8.0	1740	E/	8.0
Lead		86.7		1.0		B/U	1.4		U/	1.0		U/	1.0
Magnesium			B/U	8.6		B/U	17.7	38100	/	7.0	37900	/	7.0
Manganese	3,300 - 275		U/	1.0		U/	1.0	119	/	1.0	117	/	1.0
Mercury			U/	0.2		U/	0.2		U/	0.2		U/	0.2
Nickel			U/	1.0		U/	1.0		B/U	2.5		B/U	2.5
Potassium			UE/	22.0		BE/U	35.1	3580	BE/	22.0	3430	BE/	22.0
Selenium			U/	2.0		U/	2.0		U/	2.0		U/	2.0
Silver			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Sodium			U/	36.0		U/	36.0	14100	/	36.0	14500	/	36.0
Thallium	2.4 - .2		U/	3.0		U/	3.0		U/	3.0		U/	3.0
Vanadium			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Zinc			B/U	17.4		B/U	6.1		B/U	8.3		B/U	8.9

1. All results in ug/L.. Dissolved results are from field 0.45 um filtered sample aliquot. Total results were not filtered.
2. LQ/DVQ = Laboratory Qualifier/Data Validation Qualifier Definitions:
 - B This flag is applied to a value greater than or equal to the instrument detection limit (IDL), but less than the Practical Quantitation Limit (PQL). (e.g., used by the EPA to indicate the results is 'bracketed' by the ICL and CRDL. This laboratory qualifier does not indicate blank contamination for inorganic analyses.)
 - E Interferences were encountered during the ICP analysis.
 - U Indicates analyte was analyzed for, but was not detected above the Reported Detection Limit (RDL). If the U flag is in the DVQ position, the analyte was detected in the blank and the result has been qualified as undetected, with the RDL set at the sample concentration.

Table 8

**Summary of Metals Detections
Lower Aquifer Investigation
Amercian Chemical Service, Inc.
Griffith, Indiana**

	Remediation Level (ug/L)	APD-GW-MW29						APD-GW-MW30					
		Total	LQ/DVQ	RDL	Dissolved	LQ/DVQ	RDL	Total	LQ/DVQ	RDL	Dissolved	LQ/DVQ	RDL
Aluminum		131	B/	13.0		U/	13.0		B/U	84.3		B/U	36.9
Antimony			U/	2.0	3.4	B/	2.0		U/	2.0		U/	2.0
Arsenic			U/	3.0		U/	3.0		B/U	3.6		U/	3.0
Barium		62.0	B/	1.0	69.7	BE/	1.0	181	B/	1.0	162	BE/	1.0
Beryllium			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Cadmium			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Calcium		65200	/	18.0	75800	/	18.0	99100	/	18.0	92200	/	18.0
Chromium		16.4	/	1.0		U/	1.0	8.9	B/	1.0		U/	1.0
Cobalt		1.0	B/	1.0		U/	1.0	1.4	B/	1.0	1.0	B/	1.0
Copper			B/U	5.8		U/	1.0		B/U	1.1		U/	1.0
Iron		3030	/	8.0	2390	E/	8.0	5980	/	8.0	3820	E/	8.0
Lead			/U	4.6		U/	1.0		B/U	1.9		U/	1.0
Magnesium		33500	/	7.0	39500	/	7.0	51000	/	7.0	48400	/	7.0
Manganese	3,300 - 275	218.0	/	1.0	229	/	1.0	223	/	1.0	203	/	1.0
Mercury			U/	0.2		U/	0.2		U/	0.2		U/	0.2
Nickel		20.1	B/	1.0		B/U	5.8	21.9	B/	1.0		B/U	15.3
Potassium		7040	E/	22.0	7760	E/	22.0	4980	BE/	22.0	4910	BE/	22.0
Selenium			B/U	2.2		U/	2.0		U/	2.0		B/U	2.1
Silver			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Sodium		50700	/	36.0	60200	/	36.0	40900	/	36.0	39500	/	36.0
Thallium	2.4 - .2		U/	3.0		U/	3.0		U/	3.0		U/	3.0
Vanadium			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Zinc			B/U	19.7		B/U	9.5		B/U	8.0		B/U	4.7

1. All results in ug/L. Dissolved results are from field 0.45 um filtered sample aliquot, Total results were not filtered.

2. LQ/DVQ = Laboratory Qualifier/Data Validation Qualifier Definitions:

B This flag is applied to a value greater than or equal to the instrument detection limit (IDL), but less than the Practical Quantitation Limit (PQL). (e.g., used by the EPA to indicate the results is 'bracketed' by the ICL and CRDL. This laboratory qualifier does not indicate blank contamination for inorganic analyses.)

E Interferences were encountered during the ICP analysis.

U Indicates analyte was analyzed for, but was not detected above the Reported Detection Limit (RDL). If the U flag is in the DVQ position, the analyte was detected in the blank and the result has been qualified as undetected, with the RDL set at the sample concentration.

Table 8

**Summary of Metals Detections
Lower Aquifer Investigation
Amercian Chemical Service, Inc.
Griffith, Indiana**

	Remediation Level (ug/L)	APD-GW-MW31						APD-GW-MW32					
		Total	LQ/DVQ	RDL	Dissolved	LQ/DVQ	RDL	Total	LQ/DVQ	RDL	Dissolved	LQ/DVQ	RDL
Aluminum			B/U	88.5		B/U	31.5	766	/	13.0		B/U	37.3
Antimony		2.7	B/	2.0	2.6	B/	2.0		U/	2.0		U/	2.0
Arsenic			B/U	4.1		U/	3.0		B/U	3.7		U/	3.0
Barium		200	/	1.0	195	BE/	1.0	62.6	B/	1.0	54.2	BE/	1.0
Beryllium			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Cadmium			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Calcium		80900	/	18.0	79800	/	18.0	49100	/	18.0	52600	/	18.0
Chromium		13.6	/	1.0		U/	1.0	9.2	B/	1.0		U/	1.0
Cobalt		2.0	B/	1.0	1.1	B/	1.0		U/	1.0		U/	1.0
Copper			B/U	3.6		B/U	2.2		B/U	3.4		U/	1.0
Iron		2640	/	8.0	1770	E/	8.0	1550	/	8.0		BE/U	32.3
Lead			B/U	2.1		U/	1.0		B/U	2.1		U/	1.0
Magnesium		33900	/	7.0	33800	/	7.0	23200	/	7.0	25100	/	7.0
Manganese	3,300 - 275	122	/	1.0	117	/	1.0	219	/	1.0	212	/	1.0
Mercury			U/	0.2		U/	0.2		U/	0.2		U/	0.2
Nickel		32.6	B/	1.0	40.7	/	1.0	8.6	B/	1.0		B/U	3.7
Potassium		3870	BE/	22.0	3970	BE/	22.0	5560	/E	22.0	6230	/E	22.0
Selenium			U/	2.0		B/U	2.3		U/	2.0		U/	2.0
Silver			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Sodium		17500	/	36.0	17700	/	36.0	55000	/	36.0	61600	/	36.0
Thallium	2.4 - .2		U/	3.0		U/	3.0		U/	3.0		U/	3.0
Vanadium			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Zinc			B/U	8.2		B/U	8.6		B/U	16.0		B/U	7.7

- All results in ug/L. Dissolved results are from field 0.45 um filtered sample aliquot, Total results were not filtered.
- LQ/DVQ = Laboratory Qualifier/Data Validation Qualifier Definitions:
 - B This flag is applied to a value greater than or equal to the instrument detection limit (IDL), but less than the Practical Quantitation Limit (PQL). (e.g., used by the EPA to indicate the results is 'bracketed' by the ICL and CRDL. This laboratory qualifier does not indicate blank contamination for inorganic analyses.)
 - E Interferences were encountered during the ICP analysis.
 - U Indicates analyte was analyzed for, but was not detected above the Reported Detection Limit (RDL). If the U flag is in the DVQ position, the analyte was detected in the blank and the result has been qualified as undetected, with the RDL set at the sample concentration.

Table 8

**Summary of Metals Detections
Lower Aquifer Investigation
Amercian Chemical Service, Inc.
Griffith, Indiana**

	Remediation Level (ug/L)	APD-GW-MW32 DUP						APD-GW-MW33					
		Total	LQ/DVQ	RDL	Dissolved	LQ/DVQ	RDL	Total	LQ/DVQ	RDL	Dissolved	LQ/DVQ	RDL
Aluminum		1909	/	13.0		B/U	51.1		B/U	165		B/U	44.0
Antimony			U/	2.0	2.2	B/	2.0		U/	2.0		U/	2.0
Arsenic			B/U	3.8		U/	3.0		B/U	4.5		B/U	4.1
Barium		72.7	B/	1.0	56.2	BE/	1.0	902	/	1.0	991	/E	1.0
Beryllium			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Cadmium			U/	1.0		U/	1.0	1.4	B/	1.0	1.3	B/	1.0
Calcium		56500	/	18.0	54500	/	18.0	248000	/	18.0	259000	/	18.0
Chromium		10.6	/	1.0		U/	1.0	15.4	/	1.0		U/	1.0
Cobalt			U/	1.0		U/	1.0	6.1	B/	1.0	5.5	B/	1.0
Copper			B/U	1.6		U/	1.0		B/U	4.6		U/	1.0
Iron		1880	/	8.0	15.5	BE/	8.0	24600	/	8.0	26300	E/	8.0
Lead			B/U	1.5		U/	1.0		/U	3.7		U/	1.0
Magnesium		26800	/	7.0	26300	/	7.0	56900	/	7.0	60300	/	7.0
Manganese	3,300 - 275	250	/	1.0	220	/	1.0	686	/	1.0	711	/	1.0
Mercury			U/	0.2		U/	0.2		U/	0.2		U/	0.2
Nickel		9.7	B/	1.0		B/U	2.8	48.2	/	1.0	32.7	B/	1.0
Potassium		6470	E/	22.0	6660	E/	22.0	13900	E/	22.0	15500	E/	22.0
Selenium			B/U	2.1		U/	2.0		B/U	3.3		B/U	2.8
Silver			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Sodium		63400	/	36.0	64700	/	36.0	188000	/	36.0	203000	/	36.0
Thallium	2.4 - .2		U/	3.0		U/	3.0	3.8	B/	3.0		U/	3.0
Vanadium			U/	1.0		U/	1.0	1.8	B/	1.0	1.7	B/	1.0
Zinc			B/U	9.6		B/U	4.1		/U	34.2		B/U	18.4

- All results in ug/L. Dissolved results are from field 0.45 um filtered sample aliquot, Total results were not filtered.
- LQ/DVQ = Laboratory Qualifier/Data Validation Qualifier Definitions:
 - B** This flag is applied to a value greater than or equal to the instrument detection limit (IDL), but less than the Practical Quantitation Limit (PQL). (e.g., used by the EPA to indicate the results is 'bracketed' by the ICL and CRDL. This laboratory qualifier does not indicate blank contamination for inorganic analyses.)
 - E** Interferences were encountered during the ICP analysis.
 - U** Indicates analyte was analyzed for, but was not detected above the Reported Detection Limit (RDL). If the U flag is in the DVQ position, the analyte was detected in the blank and the result has been qualified as undetected, with the RDL set at the sample concentration.

Table 8

**Summary of Metals Detections
Lower Aquifer Investigation
Amercian Chemical Service, Inc.
Griffith, Indiana**

	Remediation Level (ug/L)	APD-GW-MW34						APD-GW-MW35					
		Total	LQ/DVQ	RDL	Dissolved	LQ/DVQ	RDL	Total	LQ/DVQ	RDL	Dissolved	LQ/DVQ	RDL
Aluminum			B/U	59.7		U/	13.0		B/U	75.9		U/	13.0
Antimony		2.1	B/	2.0	2.7	B/	2.0		U/	2.0	2.9	B/	2.0
Arsenic			U/	3.0		U/	3.0		U/	3.0		U/	3.0
Barium		151	B/	1.0	126	BE/	1.0	54.2	B/	1.0	50.6	BE/	1.0
Beryllium			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Cadmium			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Calcium		78500	/	18.0	73700	/	18.0	32300	/	18.0	30100	/	18.0
Chromium		2.9	B/	1.0	1.4	B/	1.0	6.9	B/	1.0		U/	1.0
Cobalt		1.3	B/	1.0		U/	1.0	1.2	B/	1.0		U/	1.0
Copper			B/U	2.9		B/U	1.8	6.1	B/	1.0		B/U	1.3
Iron		4360	/	8.0	890	E/	8.0	1160	/	8.0	8.0	E/	8.0
Lead			B/U	1.8		U/	1.0		B/U	1.9		U/	1.0
Magnesium		46000	/	7.0	42600	/	7.0	22200	/	7.0	21800	/	7.0
Manganese	3,300 - 275	138	/	1.0	126	/	1.0	87.8	/	1.0	65.8	/	1.0
Mercury			U/	0.2		U/	0.2		U/	0.2		U/	0.2
Nickel			B/U	3.8		B/U	4.9	16.5	B/	1.0		B/U	7.3
Potassium		5810	E/	22.0	5240	E/	22.0	7130	E/	22.0	7090	E/	22.0
Selenium			B/U	2.7		U/	2.0		U/	2.0		U/	2.0
Silver			U/	1.0		U/	1.0		U/	1.0		U/	1.0
Sodium		26600	/	36.0	25000	/	36.0	16000	/	36.0	15800	/	36.0
Thallium	2.4 - .2		U/	3.0		U/	3.0		U/	3.0		U/	3.0
Vanadium		1.1	B/	1.0		U/	1.0		U/	1.0		U/	1.0
Zinc			B/U	11.7		B/U	10.6		B/U	8.4	5.2	B/U	5.2

1. All results in ug/L. Dissolved results are from field 0.45 um filtered sample aliquot, Total results were not filtered.

2. LQ/DVQ = Laboratory Qualifier/Data Validation Qualifier Definitions:

B This flag is applied to a value greater than or equal to the instrument detection limit (IDL), but less than the Practical Quantitation Limit (PQL). (e.g., used by the EPA to indicate the results is 'bracketed' by the ICL and CRDL. This laboratory qualifier does not indicate blank contamination for inorganic analyses.)

E Interferences were encountered during the ICP analysis.

U Indicates analyte was analyzed for, but was not detected above the Reported Detection Limit (RDL). If the U flag is in the DVQ position, the analyte was detected in the blank and the result has been qualified as undetected, with the RDL set at the sample concentration.

Table 8

**Summary of Metals Detections
Lower Aquifer Investigation
Amercian Chemical Service, Inc.
Griffith, Indiana**

	Remediation Level (ug/L.)	APD-GW-MW36					
		Total	LQ/DVQ	RDL	Dissolved	LQ/DVQ	RDL
Aluminum			B/U	55.8		U/	13.0
Antimony			U/	2.0		U/	2.0
Arsenic			U/	3.0		U/	3.0
Barium		140	B/	1.0	141	BE/	1.0
Beryllium			U/	1.0		U/	1.0
Cadmium			U/	1.0		U/	1.0
Calcium		70600	/	18.0	72000	/	18.0
Chromium			U/	1.0		U/	1.0
Cobalt		1.1	B/	1.0	1.3	B/	1.0
Copper			U/	1.0		U/	1.0
Iron		2890	/	8.0	2830	E/	8.0
Lead			U/	1.0		U/	1.0
Magnesium		48100	/	7.0	48800	/	7.0
Manganese	3,300 - 275	145	/	1.0	151	/	1.0
Mercury			U/	0.2		U/	0.2
Nickel		12.3	B/	1.0		B/U	12.5
Potassium		6990	E/	22.0	6960	E/	22.0
Selenium			U/	2.0		U/	2.0
Silver			U/	1.0		U/	1.0
Sodium		25900	/	36.0	26700	/	36.0
Thallium	2.4 - .2		U/	3.0		U/	3.0
Vanadium			U/	1.0		U/	1.0
Zinc		7.2	B/U	7.2		B/U	8.4

1. All results in ug/L. Dissolved results are from field 0.45 um filtered sample aliquot, Total results were not filtered.

2. LQ/DVQ = Laboratory Qualifier/Data Validation Qualifier Definitions:

B This flag is applied to a value greater than or equal to the instrument detection limit (IDL), but less than the Practical Quantitation Limit (PQL). (e.g., used by the EPA to indicate the results is 'bracketed' by the ICL and CRDL. This laboratory qualifier does not indicate blank contamination for inorganic analyses.)

E Interferences were encountered during the ICP analysis.

U Indicates analyte was analyzed for, but was not detected above the Reported Detection Limit (RDL). If the U flag is in the DVQ position, the analyte was detected in the blank and the result has been qualified as undetected, with the RDL set at the sample concentration.

Table 8A

**Manganese Distribution
New Lower Aquifer Monitoring Wells
American Chemical Services, Inc.
Griffith, Indiana**

MW Number	Total Manganese	Dissolved Manganese	Standard Deviations from Average
MW28	119	117	-0.50
MW29	218	229	0.07
MW30	223	203	-0.06
MW31	122	117	-0.50
MW32	219	212	-0.01
MW33	686	711	2.56
MW34	138	126	-0.46
MW35	87.8	65.8	-0.77
MW36	145	151	-0.33
Mean:	218	215	
S.D.:	183	194	

Notes:

Inorganic analytical data is presented in Appendix I.

S.D. = Standard Deviation

Table 8B
Summary of Groundwater Analytical Results
Exceedences of Remediation Levels- SVOCs
Lower Aquifer Investigation
American Chemical Service, Inc.
Griffith, Indiana

Compound	Remediation Level (ug/L)	Sample Designation										
		MW28	MW29	MW30	MW31	MW32	MW32 Dup	MW33	MW34	MW35	MW36	API-GW-Rinsate
Metals												
SVOCs												
Bis (2-ethyl hexyl)phthalate	5.8	nd	27	68	nd	30	32	nd	nd	11	nd	nd

Notes:

Only compounds noted as having exceedences are listed

Exceedences are indicated with **Bold** print

nd - compound not detected

Table 9
Summary of Groundwater Analytical Results
Detected VOCs - Production Well Sampling
Lower Aquifer Investigation
American Chemical Service, Inc.
Griffith, Indiana

Compound	Remediation Levels (ug/L)	Sample Identification Number					
		IW1-01	IW1-91	IW2-01	IW3-01	IW4-01	IWTB-01
Acetone	2300 - 192	14	ND	ND	ND	ND	ND
1,2-Dichloroethene	330 - 28	3 J	3 J	ND	ND	ND	ND
2-Butanone	24000 - 2000	11	ND	ND	ND	ND	ND
Trichloroethene	5	5 J	5 J	ND	ND	ND	ND
1,1,2-Trichloroethane	na	2 J	ND	ND	ND	ND	ND
Bromoform	na	2 J	ND	ND	ND	ND	ND
4-methyl-2-pentanone	640 - 53	7 J	ND	ND	ND	ND	ND
Tetrachloroethene	5	10 J	10	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	na	5 J	ND	ND	ND	ND	ND
Toluene	na	ND	ND	ND	ND	1 J	ND
Ethyl benzene	390 - 33	ND	ND	ND	ND	4 J	ND
Xylene	na	ND	ND	ND	ND	13	ND

Notes:

Analytical results are presented in micrograms per liter (ug/l)

ND = Not Detected

J = Estimated concentration

IW1-01 = ACS production well number, sample event number one.

IW1-91 = ACS production well number, duplicate sample.

Exceedences of Remediation Objectives noted in **Bold** print

Table 11
Field Identified Wells
American Chemical Service, Inc.
Griffith, Indiana

Well Number*	Well Usage/Owner	Well Location (Address)
A	Residential Well	1007 Reder Road
B	Residential Well	1009 Reder Road
C	Residential Well	1029 Reder Road
D	Residential Well	1033 Reder Road
E	Industrial - M&R Truck Repair	1045 Reder Road
F	Industrial Usage - Clean Cities Recycling	1010/1012 Reder Road
G	Production Well - Weldco	1020 Reder Road
H	Residential Well	938 Arbogast
I	Production Well - Aeromet	739 South Arbogast
J	Residential Well	1008 South Arbogast
K	Residential Well	1014 South Arbogast
L	Residential Well	1026 South Arbogast
M	Residential Well	940 South Arbogast
N	Residential Well	420 Avenue H
O	Residential Well	430 Avenue H
P	Production Well - ACS	420 South Colfax
Q	Production Well - ACS	420 South Colfax

Note:

* Well numbers correspond with numbers noted on EDR "Well Search" map.

2.5 MONITORING WELL SAMPLING

To determine the horizontal and vertical extent of contamination in the lower aquifer and confirm the results of the vertical profiling, new lower aquifer monitoring wells at the site were sampled on March 12 to 14, 1996 for VOCs, semi-volatile compounds, PCBs and metals (total and dissolved). Sampling was conducted in accordance with the approved March 1996 Groundwater Monitoring Well Sampling SOP for the Lower Aquifer Investigation with the following exception:

- For dissolved metals analysis, the samples were not filtered using an in-line filtering device connected to the discharge line of the sampling pump. The inside diameter of the line was too large to provide a sufficient seal to allow water to pass through the filter. Therefore, filtering was conducted by filling a one-liter polyethylene container with the water sample and using a peristaltic pump with an attached 0.45 micron in-line filter to pump water through the filter. The sample was filtered immediately (within ten minutes) following collection.

Monitoring well sampling forms are included as Appendix E.

2.6 PRIVATE WELL IDENTIFICATION

Although not included in the Scope of Work for the Lower Aquifer Investigation, a private well identification process was initiated in the vicinity (e.g. 2-mile radius) of the ACS site because of findings in the Upper Aquifer Investigation. The well search was intended to build on the well location data presented in the RI report and the Upper Aquifer Technical Memorandum. During the field investigation, the water well identification program was focused on homes and businesses located along South Colfax Avenue and Main Street in the vicinity of ACS, and along Reder Road, Arbogast Avenue, and Avenue H. Since the field investigation, the newest data base of water wells was obtained from the Indiana Department of Natural Resources for the communities in a two-mile radius of the site. This new data base, along with the wells identified during the field investigation have been used to supplement the water well data base developed during the RI.